SELECTIVE CALL HT220

" HANDIE-TALKIE" FM RADIOS

450-470 MHz 1.0 & 4.0 W RF POWER

SUPPLEMENTARY INSTRUCTIONS

TO

INSTRUCTION MANUAL

68P81001C80

68P81001C85-D

PERFORMANCE SPECIFICATIONS - H24FFN SERIES (1-WATT)

GENERAL

MODELS*		TWO-REED (SINGLE CODE)		FOUR-REED (DUAL CODE)	
		INTERNAL SPKR-MIC	REMOTE SPKR-MIC	INTERNAL SPKR-MIC	REMOTE SPKR-MIC
POWER SUPPLY		(1) Mercury Battery, or (1) Nickel-Cadmium Battery			
BATTERY DRAIN Standby (@15.0 V dc) Receive (@15.0 V dc) Transmit (@15.0 V dc)		7.0 mA 65 mA 300 mA	7.0 mA 65 mA 320 mA	8.5 mA 65 mA 300 mA	8.5 mA 65 mA 320 mA
BATTERY LIFE (based on 10% xmit; 10% rec. with rated af output; 80% standby)	Merc. Batt.	40 hours			
	Ni-Cd Batt.	8 hours per charge			
DIMENSIONS (less antenna and knobs)	Height Width Depth	6.95"x 2.75"x 1.80"	6.95"x 3.19"x 1.80"	6.95"x 2.75"x 1.80"	6.95"x 3.19"x 1.80"
WEIGHT (includes battery)	Merc. Battery	29.5 oz.	28.5 oz.**	31.5 oz.	30.5 oz.**
	Ni-Cd Battery	30.0 oz.	29.0 oz.**	32.0 oz.	31.0 oz.**

*For "Private-Line" tone on transmit versions of any model, add: 1.) 5 mA to transmit drain
**Excludes 4.0 ounce weight of remote speaker-microphone unit. 2.) 0.63 inch to height
3.) 2 ounces to weight

TRANSMITTER

RF OUTPUT (Mercury battery) (Nickel-cadmium battery)	 0.7 watt @ 12.7 volts dc 1.0 watt @15.0 volts dc
FREQUENCY STABILITY	±.0005% from -30° to +60°C (25° reference)
MODULATION	Type 16F3, ±5 kHz for 100% modulation at 1000 Hz
CRYSTAL MULT.	27 times
SPURIOUS & HARMONICS	More than 43 dB below carrier
FM NOISE	At least 40 dB below ±3.3 kHz deviation at 1000 Hz
AUDIO RESPONSE	+1, -3 dB from 6 dB/octave pre-emphasis characteristic from 300 - 3000 Hz
AUDIO DISTORTION	Less than 10% at 1000 Hz, 2/3 max. rated deviation
MAX. PERMISSIBLE CHANNEL SEP.	5 MHz no degradation
FREQUENCY RANGE	450 - 470 MHz

RECEIVER

AUDIO OUTPUT	500 mW at less than 10% distortion
FREQUENCY STABILITY	±.0010% from -30° to +60°C (+25° reference), ±.0005% from -10° to +60°C
MODULATION ACCEPTANCE	±7.5 kHz
SPURIOUS & IMAGE REJECTION	RF image more than 40 dB below carrier All others more than 50 dB below carrier
SENSITIVITY	.35 uV (12 dB Sinad), .50 uV max. (20 dB quieting)
SELECTIVITY	More than 70 dB at ±25 kHz (20 dB quieting) More than 60 dB at ±25 kHz (EIA SINAD)
NOISE SQUELCH SENSITIVITY	Noise compensated type, adjustable, will open at less than 0.25 uV
PAGING SENSITIVITY	Fixed sensitivity will open at less than 0.25 uV
MAX. PERMISSIBLE CHANNEL SEP.	1 MHz (no degradation)
INTERMODULATION	More than 60 dB at adjacent channel
CHANNEL SPACING	25 kHz
FREQUENCY RANGE	450-470 MHz

FCC LICENSE DESIGNATION: CC4094

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4) the division of extremely long schematics (over 17") into two or more sheets.
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Communications and Electronics Parts

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PERFORMANCE SPECIFICATIONS - H34FFN SERIES (4-WATT)

GENERAL

MODELS*	INTERNAL SPKR/MIC	REMOTE SPKR/MIC
POWER SUPPLY	Nickel-Cadmium Battery	
BATTERY DRAIN Standby (@ 15.0 V dc) Receive (@ 15.0 V dc) Transmit (@ 15.0 Vdc)	 7.0 mA 65 mA 870 mA	 7.0 mA 65 mA 890 mA
BATTERY LIFE (Based on 5% xmit; 5% rec with rated af output; 90% standby)	8 hours per charge	
DIMENSIONS -Height (less antenna Width and knobs) Depth	6.95" x 2.75" x 1.80"	6.95" x 3.19" x 1.80"
WEIGHT - (incl. Ni-Cad battery)	31.5 oz.	29.5 oz**

*For "Private-Line" tone on transmit versions of any model, add: 1.) 5 mA to transmit drain
**Excludes 5.4 ounce weight of remote speaker-microphone unit. 2.) 0.63 inch to height
3.) 2 ounces to weight

TRANSMITTER

RF OUTPUT (Nickel-cadmium battery)	4.0 watts @15.0 volts dc
FREQUENCY STABILITY	±.0005% from -30°C to +60°C (25° reference)
MODULATION	Type 16F3, ±5 kHz for 100% modulation at 1000 Hz
CRYSTAL MULTIPLICATION	27 times
SPURIOUS & HARMONICS	More than 49 dB below carrier
FM NOISE	At least 40 dB below ±3.3 kHz deviation at 1000 Hz
AUDIO RESPONSE	+1, -3 dB from 6 dB/octave pre-emphasis characteristic from 300 - 3000 Hz
AUDIO DISTORTION	Less than 10% at 1000 Hz, 2/3 max. rated deviation
MAX PERMISSIBLE CHANNEL SEP	5 MHz no degradation
FREQUENCY RANGE	450-470 MHz

RECEIVER

AUDIO OUTPUT	500 mW at less than 10% distortion
FREQUENCY STABILITY	±.0010% from -30° to +60°C (+25° reference), ±.0005% from -10° to +60°C
MODULATION ACCEPTANCE	±7.5 kHz
SPURIOUS & IMAGE REJECTION	RF image more than 40 dB below carrier All others more than 50 dB below carrier
SENSITIVITY	.35 uV (12 dB SINAD), .50 uV max (20 dB quieting)
SELECTIVITY	More than 70 dB at ±25 kHz (20 dB quieting) More than 60 dB at ±25 kHz (EIA SINAD)
NOISE SQUELCH SENSITIVITY	Noise compensated type, adjustable, will open at less than 0.25 uV
PAGING SENSITIVITY	Fixed sensitivity will open at less than 0.25 uV
MAX PERMISSIBLE CHANNEL SEP	1 MHz (No degradation)
INTERMODULATION	More than 60 dB at adjacent channel
CHANNEL SPACING	25 kHz
FREQUENCY RANGE	450 - 470 MHz

FCC LICENSE DESIGNATION: CC4095

(SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE)

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NOTE

Refer to the accompanying instruction manual for supplementary information. The radio accessories, required and options, described in the basic manual also apply to the selective call models.

MOTOROLA

MODEL CHART

FOR

SELECTIVE CALL

INTERNAL AND REMOTE SPEAKER/MICROPHONE

"HANDIE-TALKIE" FM RADIOS

450-470 MHz 1.0 W & 4.0 W RF POWER

CODE:

☒ = ONE ITEM SUPPLIED

◪ = ONE ITEM SUPPLIED, CHOICE DEPENDENT ON CARRIER OR "PRIVATE-LINE" TONE FREQUENCY

☒ = "N" ITEMS SUPPLIED, CHOICE DEPENDENT ON CARRIER OR SELECTIVE CALL FREQUENCY

◪ = ONE ITEM SUPPLIED PER 20 (OR LESS) RADIOS

MODELS	NUMBER OF XMTR FREQ	NUMBER OF RCVR FREQ	"PL" TRANSMIT ONLY	SELECTIVE CALL CODE	SPKR/MIC
		1.0 Watt Models			
24FFN-1105D	1	1	-	Single	Internal
24FFN-1106D	1	1	-	Dual	Internal
24FFN-1107D	1	1	-	Single	Remote
24FFN-1108D	1	1	-	Dual	Remote
24FFN-1115D	2	1	-	Single	Internal
24FFN-1116D	2	1	-	Dual	Internal
24FFN-1117D	2	1	-	Single	Remote
24FFN-1118D	2	1	-	Dual	Remote
24FFN-1135D	2	2	-	Single	Internal
24FFN-1136D	2	2	-	Dual	Internal
24FFN-1137D	2	2	-	Single	Remote
24FFN-1138D	2	2	-	Dual	Remote
24FFN-2105D	1	1	"Private-Line"	Single	Internal
24FFN-2106D	1	1	"Private-Line"	Dual	Internal
24FFN-2107D	1	1	"Private-Line"	Single	Remote
24FFN-2108D	1	1	"Private-Line"	Dual	Remote
24FFN-2115D	2	1	"Private-Line"	Single	Internal
24FFN-2116D	2	1	"Private-Line"	Dual	Internal
24FFN-2117D	2	1	"Private-Line"	Single	Remote
24FFN-2118D	2	1	"Private-Line"	Dual	Remote
24FFN-2135D	2	2	"Private-Line"	Single	Internal
24FFN-2136D	2	2	"Private-Line"	Dual	Internal
24FFN-2137D	2	2	"Private-Line"	Single	Remote
H24FFN-2138D	2	2	"Private-Line"	Dual	Remote
		4.0 Watt Models			
H34FFN-1105D	1	1	-	Single	Internal
H34FFN-1107D	1	1	-	Single	Remote
H34FFN-1115D	2	2	-	Single	Internal
H34FFN-1117D	2	2	-	Single	Remote
H34FFN-1135D	2	2	-	Single	Internal
H34FFN-1137D	2	2	-	Single	Remote
H34FFN-2105D	1	1	"Private-Line"	Single	Internal
H34FFN-2107D	1	1	"Private-Line"	Single	Remote
H34FFN-2115D	2	2	"Private-Line"	Single	Internal
H34FFN-2117D	2	2	"Private-Line"	Single	Remote
H34FFN-2135D	2	2	"Private-Line"	Single	Internal
H34FFN-2137D	2	2	"Private-Line"	Single	Remote

ITEM	DESCRIPTION
NUE6002BA	CHASSIS FRAME (ONE-FREQ C.S.)
NUE6012BA	CHASSIS FRAME (ONE-FREQ C.S.)
NUE6002BB	CHASSIS FRAME (TWO-FREQ C.S.)
NUE6012BB	CHASSIS FRAME (TWO-FREQ C.S.)
NUF6002BC	CHASSIS FRAME (ONE FREQ "PL")
NUE6012BC	CHASSIS FRAME (ONE-FREQ "PL")
NUE6002BD	CHASSIS FRAME (TWO-FREQ "PL")
NUE6012BD	CHASSIS FRAME (TWO-FREQ "PL")
KXN6064A	TRANSMITTER CONTROL CRYSTAL
KXN6065A	RECEIVER CONTROL CRYSTAL
KXN6019A	RECEIVER CONTROL CRYSTAL
TLN6709B	"VIBRASPONDER" RESONANT REED
TLN8904A	"VIBRASPONDER" RESONANT REED
NLN8020B	SLEEVE KIT, TWO-REED SELECTIVE CALL (C.S.) (EARLY RADIOS USED NLN8020A)
NLN8021B	SLEEVE KIT, FOUR-REED SELECTIVE CALL (C.S.) (EARLY RADIOS USED NLN8021A)
NLN8022B	SLEEVE KIT, TWO-REED SELECTIVE CALL ("PL") (EARLY RADIOS USED NLN8022A)
NLN8023B	SLEEVE KIT, FOUR-REED SELECTIVE CALL ("PL") (EARLY RADIOS USED NLN8023A)
NLN8221B	SLEEVE KIT, TWO-REED SELECTIVE CALL (C.S.) (EARLY RADIOS USED NLN8221A)
NLN8220B	SLEEVE KIT, TWO-REED SELECTIVE CALL ("PL") (EARLY RADIOS USED NLN8220A)
NLE6632A	"PRIVATE-LINE" TONE ENCODER (EARLY RADIOS USED NLN6784A ENCODER)
NLF6222A	HIGH POWER AMPLIFIER
NLN8027B	UNIT HARDWARE KIT SELECTIVE CALL (ONE-FREQ C.S.)
NLN8028B	UNIT HARDWARE KIT SELECTIVE CALL (TWO-FREQ C.S.)
NLN8029B	UNIT HARDWARE KIT SELECTIVE CALL (ONE-FREQ "PL")
NLN8030B	UNIT HARDWARE KIT SELECTIVE CALL (TWO-FREQ "PL")
NLN8222A	UNIT HARDWARE KIT, HIGH POWER AMPLIFIER
NLN6752A	BATTERY COVER
NLN8419A	BACK COVER
NLN8427A	BACK COVER
NLN8420A	BACK COVER
NLN8428A	BACK COVER
NLN8370A	FRONT COVER
NLN8128A	FRONT COVER
NLN8382A	FRONT COVER
NLN8386A	FRONT COVER
NLN8371A	FRONT COVER
NLN8373A	FRONT COVER
NLN8383A	FRONT COVER
NLN8131A	FRONT COVER
NLN6689A	TUNING TOOL KIT
NLN6690A	NAMEPLATE KIT
NLN6840A	CODE IDENTIFICATION LABEL
NLN6761	NICKEL-CADMIUM BATTERY
NLN6845A	CARRYING CASE
NLN6846A	CARRYING CASE

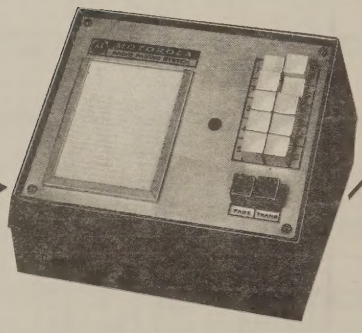
EPF-751-B

Typical Selective Radio Paging System

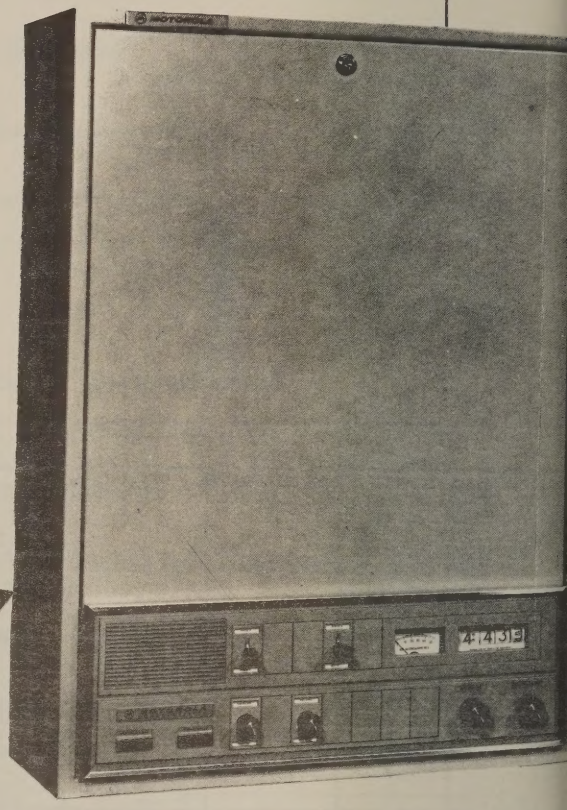
RADIO POCKET PAGER
These units are carried by personnel and are a receiver-only portion of the system. The units alert the paged party and receive the voice message but are incapable of transmission.

SELECTIVE "HANDIE-TALKIE" RADIO
These units are carried by personnel and are used to alert the person being paged. After alerting the person, a two-way conversation may be held since the units are capable of both transmitting and receiving. Calls may also be originated by this unit.

MICROPHONE
This microphone acts as the source element for voice messages.



N1016B - N1019B SELECTIVE PAGING ENCODER
The encoder originates coded paging tones and keys the transmitter.



BASE STATION
This station is available in a variety of models or the existing equivalent station may be used. It provides the radio carrier for selective paging signals and voice and amplifies any received messages.

Selective Radio Paging System
Pictorial Detail
Motorola No. PEPF-775-A
8/14/74 - JS

1. DESCRIPTION

The H24FFN Series (1-watt) and H34FFN Series (4-watt) Selective Call Model Radios described in this supplement are similar to the counterpart 1-watt and 4-watt carrier squelch model radios described in the attached instruction manual. The unique feature of these radios is the selective calling capability, with optional "Private-Line" tone on transmit. Thus, each radio may be operated as a two-way communications unit, like the basic model and/or as a pager in a Motorola selective call radio paging system.

Selective call circuitry, essentially an audio decoder, allows the radio receiver to respond only to a particular sequence of coded tones which are transmitted from an associated radio paging station (see Selective Radio Paging System detail). The tone sequence may be used for calling an individual radio or a group of radios.

The "Private-Line" tone on transmit option adds a tone oscillator or encoder for use with the transmitter to provide "PL" encoded carrier signals. This is especially useful when transmissions are to be directed to a specific location within a radio network where many receivers monitor the same frequency. Assuming all receivers within the network are equipped with the "PL" on transmit option, only the "PL" receiver equipped to decode a tone code identical to that being transmitted will deliver audio at its speaker. Refer to the model chart in the front of this supplement for a complete listing of models available with this option.

2. OPERATION

a. Preoperational Notes

The PREOPERATIONAL NOTES in the attached instruction manual are fully applicable to these selective call models.

b. Operation

NOTE

The operator must be aware that when the P-T switch is in the P (page) position, the radio is in pager operation; only an alert tone can be heard and no voice messages can be received. When the P-T switch is in the T (talk) position, the unit functions as a normal two-way radio capable of receiving and transmitting.

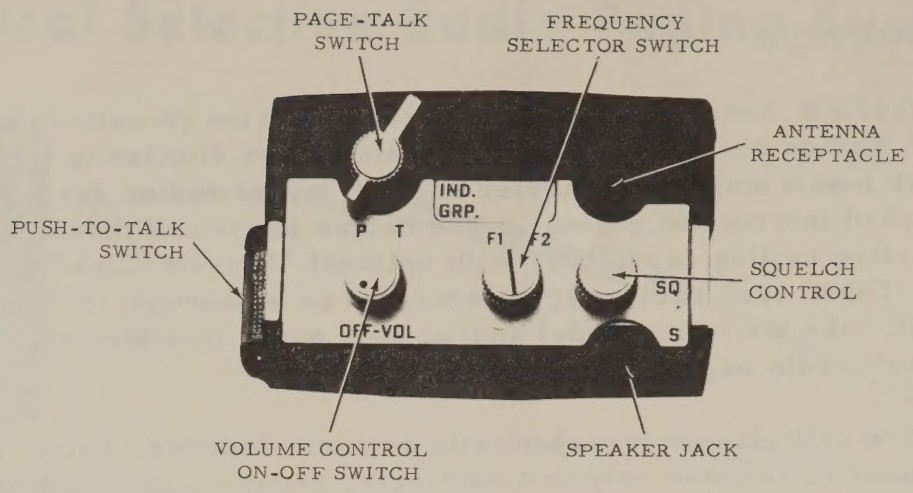


Figure 1. Controls Location Detail

(1) To Turn On - Place the P-T (page-talk) switch in the T position. Turn the OFF-VOL control in a clockwise direction until a "click" is heard. This places the unit in an operational standby condition.

(2) To Adjust Receiver Audio Volume - With a signal being received, turn the SQUELCH control fully counterclockwise. Adjust the OFF-VOL control until the desired volume level is obtained at the speaker.

(3) To Adjust the Squelch Control - Turn the SQUELCH control fully counterclockwise. With no signal being received, turn the SQUELCH control clockwise until the noise coming from the speaker just cuts out (squelches). The receiver is now set to threshold squelch.

(4) To Monitor Voice - To monitor all on-frequency transmissions, leave the P-T switch in the T position.

(5) Pager Operation - Place the P-T switch in the P position. When the alert tone sounds, place the P-T switch in the T position in order to receive the voice message which follows the alert tone.

NOTE

The level of the alert tone will be decreased by removing jumper JU401 across capacitor C422 on the selective call printed circuit board. This will not affect the level of the received voice message.

(6) To Transmit - Listen for a clear channel before transmitting to insure non-interference with others using the same channel. The P-T switch must be in the T position in order to listen as well as to transmit. Hold the radio, or remote unit, with the speaker/microphone grille approximately one or two inches from the lips. Press the push-to-talk switch firmly, and speak in a natural tone of voice directly into the microphone. For best results speak slowly and distinctly. Release the push-to-talk switch when you finish speaking.

(7) To Select an Operating Frequency (Two-Frequency Models) - Set the frequency selector switch to the desired frequency (F1 through F4). On two frequency (T2 - R2) models, F2 selects the F2 frequency as indicated. However, on two-frequency (T2-R1) models, F2 selects the transmit frequency or the F1 receive frequency, as applicable.

(8) To Turn Off - To turn the radio off, turn the OFF-VOL control in the counter-clockwise direction until a "click" is heard.

(9) Storage - Battery considerations must be made when contemplating radio storage. If the radio is equipped with a mercury battery, the battery must be removed before storing the unit for a long period of time. If equipped with a nickel-cadmium battery, refer to the battery storage information presented in the accompanying manual.

3. DESCRIPTION OF ITEMS

NOTE

Only those items unique to selective call models are described in this supplement. All common items are fully described in the attached instruction manual.

a. Chassis Frame

The carrier squelch model chassis frame is identical to its counterpart described in the attached instruction manual, except for minor changes required for compatibility with the added selective call circuitry. For example, a change resulting from the addition of the selective call circuitry is the removal of receiver coupling capacitor C58.

The "PL" model chassis frame is significantly different than its counterpart described in the attached manual. In addition to the aforementioned chassis changes, the "PL" chassis is modified for replacement of the standard "PL" tone encoder-decoder circuit board with a "PL" tone encoder board. Also, on the one-frequency "PL" chassis frame, "PL" ON-OFF toggle switch S4 is removed.

Diagrams applicable to the transmitter and receiver as adapted for selective call operation are included in this supplement.

b. "Vibrasponder" Resonant Reed

The "Vibrasponder" resonant reed is the frequency controlling element in the selective call circuit as well as the "PL" circuit. In single-code models, two "Vibrasponder" reeds are used. This is in addition to the TLN6709B Reed required for the "PL" tone encoder, when supplied. Both TLN8904 and TLN6709 Reed types have identical ratings; they differ only in size and weight.

c. Selective Call Sleeve Kit

The two-reed selective call kit consists of a selective call printed circuit board, P-T switch, antenna receptacle, and associated wiring. The printed circuit board mounts two reed sockets, each of which accepts a plug-in "Vibrasponder" resonant reed (separately supplied). The sleeve is mounted to the chassis metal frame and secured with the cover retaining bushings.

Carrier squelch (C.S.) and "PL" variation sleeve kits differ in sleeve length. Diagrams applicable to the selective call circuit are included in this supplement.

d. "Private-Line" Encoder ("PL" on Transmit Models Only)

The "PL" encoder circuit board replaces the standard "PL" circuit board described in the attached manual and is slot-mounted in the same location. Unlike the standard "PL" circuit, this circuit has no decoder portion and is not used with a "PL" ON-OFF switch. A "Vibrasponder" resonant reed is separately supplied for use with this circuit. Diagrams applicable to the "PL" encoder are included in this supplement.

e. Miscellaneous Parts Kit

Each selective call parts kit consists of an escutcheon marked for selective call operation (and frequency selection on two-frequency model kits), a P-T knob, and miscellaneous hardware for installation of the selective call sleeve kit. The "PL" variation kit differs from the carrier squelch version mainly in that it also includes two coils and a capacitor nee for the installation of the "PL" tone encoder board.

f. Code Identification Label

The code identification label specifies the individual call or group call code of the particular "Handie-Talkie" radio.

4. THEORY OF OPERATION

a. General

The general theory of operation presented in the attached instruction manual is also applicable to the selective call models, except that the "Private-Line" tone on transmit models (here "Private-Line" refers only to the encoding function) includes a "PL" tone encoder which is part of the transmitter only. Another significant difference is the selective call circuitry in the receiver. The single-code model circuitry consists of an emitter follower, a reed driver, two "Vibrasponder" resonant reeds, two tone amplifiers, two tone detectors, an inhibit gate, a squelch gate, an oscillator, a talk-page audio gate, and a voltage regulator all mounted on a separate printed circuit board. The dual-code models include two of these boards, identical except for resonant frequencies and "Vibrasender" reeds.

b. Circuit Theory

(1) Transmitter (H24FFN 1-Watt Models) Refer to Figure 2

The transmitter circuit theory in the attached manual is applicable, except that on "PL" models, the "PL" tone output from isolation amplifier Q604 is applied to varactor CR101 in the oscillator circuit, the signal is then multiplied by tripler stages Q102, Q103, and Q104.

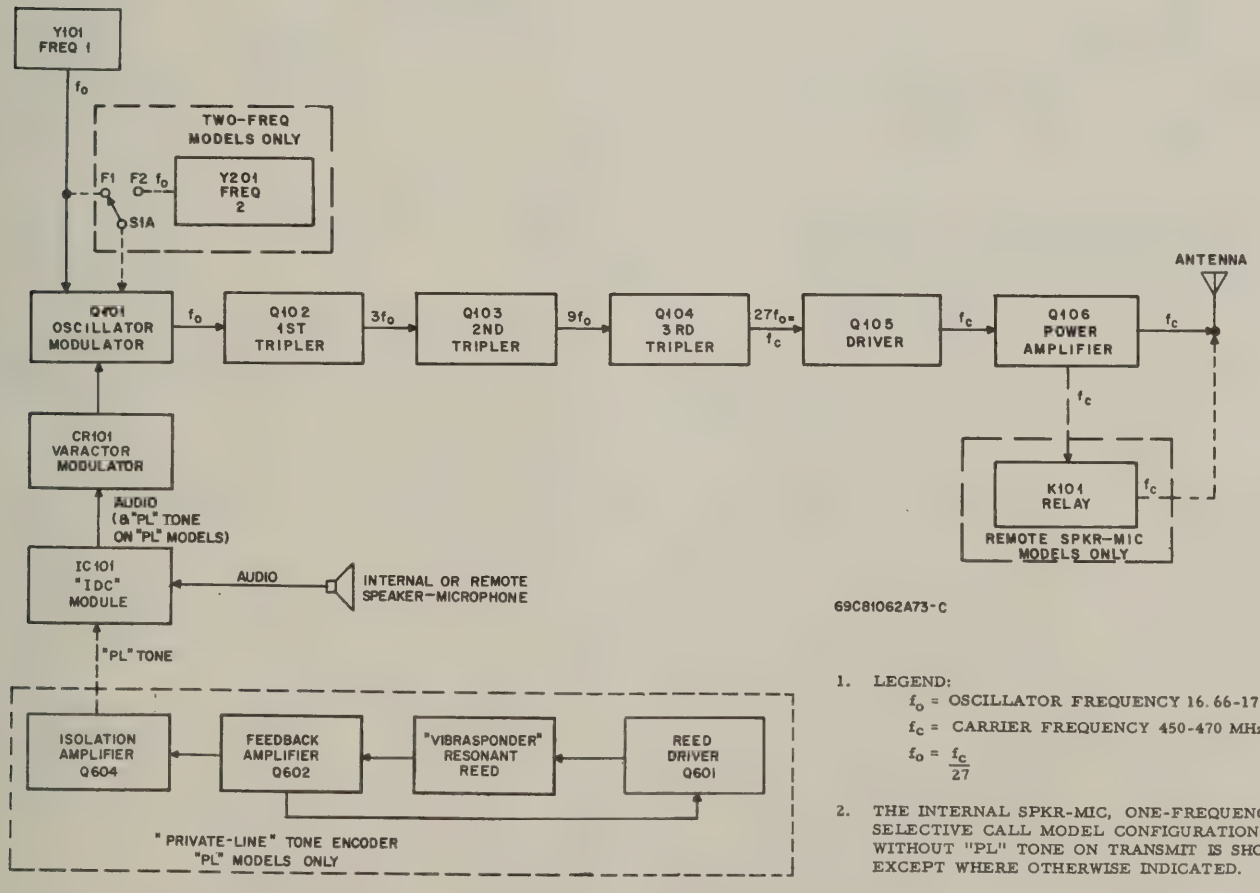
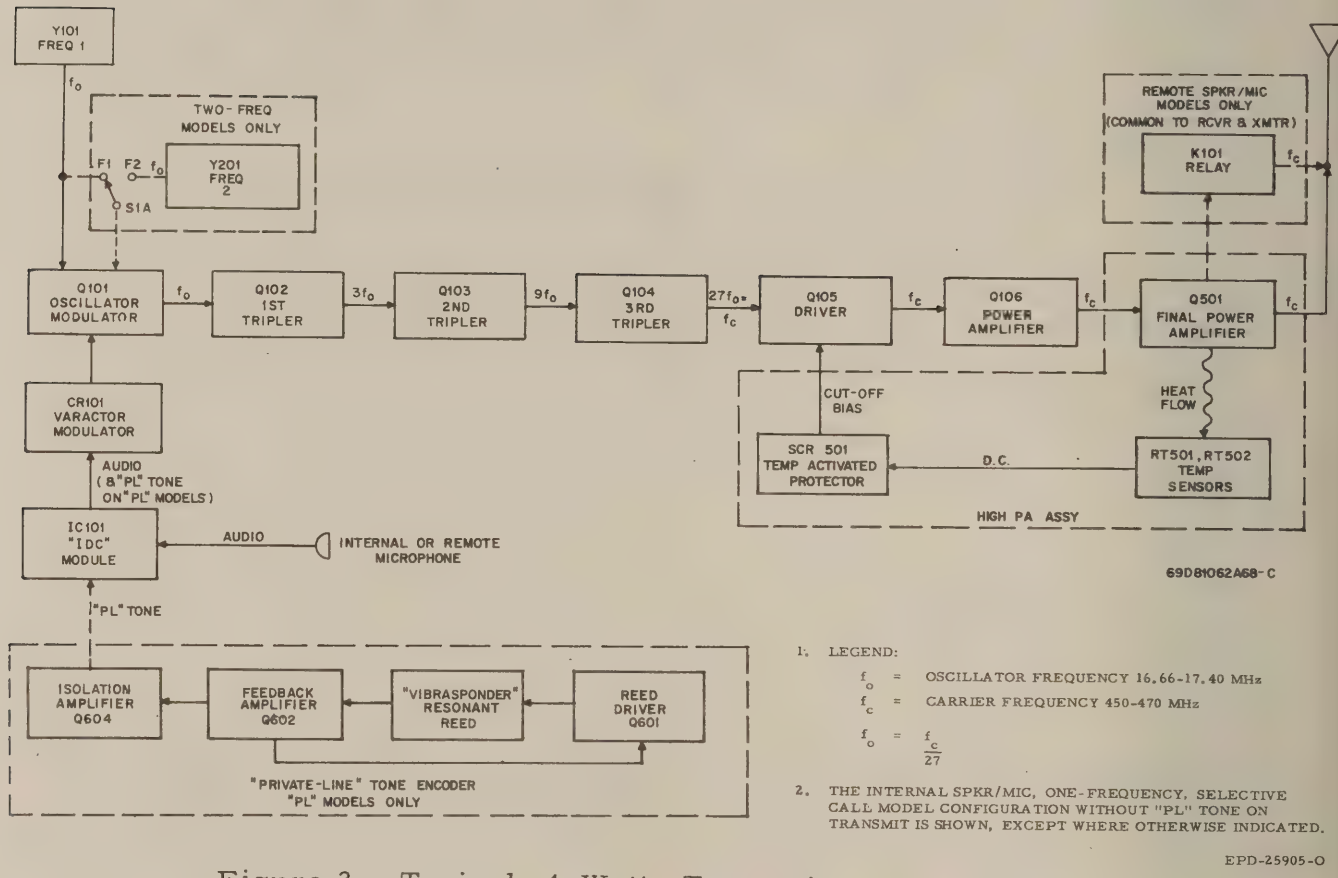


Figure 2. Typical 1-Watt Transmitter Block Diagram

(2) Transmitter (H34FFN 4-Watt Models) Refer to Figure 3

The Transmitter circuit theory in the attached manual is applicable except that on "PL" models, the "PL" tone output from isolation amplifier Q604 is applied to varactor CR101 in the oscillator circuit. The signal is then multiplied by tripler stages Q102, Q103, and Q104.



1. LEGEND:
   f_o = OSCILLATOR FREQUENCY 16.66-17.40 MHz
   f_c = CARRIER FREQUENCY 450-470 MHz
   $f_o = \frac{f_c}{27}$

2. THE INTERNAL SPKR/MIC, ONE-FREQUENCY, SELECTIVE CALL MODEL CONFIGURATION WITHOUT "PL" TONE ON TRANSMIT IS SHOWN, EXCEPT WHERE OTHERWISE INDICATED.

EPD-25905-O

Figure 3. Typical 4-Watt Transmitter Block Diagram

(3) Receiver Refer to Figure 4

The receiver circuit theory in the accompanying manual is applicable, except that the audio is coupled to the talk-page gate. In receiver operation, the P-T switch is in the T position which gates "on" the audio signal from the discriminator to the active filter Q7, allowing further amplification by Q12, Q14, Q15, and Q16. The squelch circuit operates in the same manner as a standard receiver.

During pager operation, squelch operation is different. The P-T switch is in the P position which gates "off" the audio signal between the discriminator and active filter. However, the audio signal at the discriminator is applied to the selective call decoder. If the audio signal consists of two tones of the proper frequency and sequence, it will be decoded to provide two outputs; a pure dc signal, and an audio alert tone. The pure dc signal, at zero volts, is applied to squelch

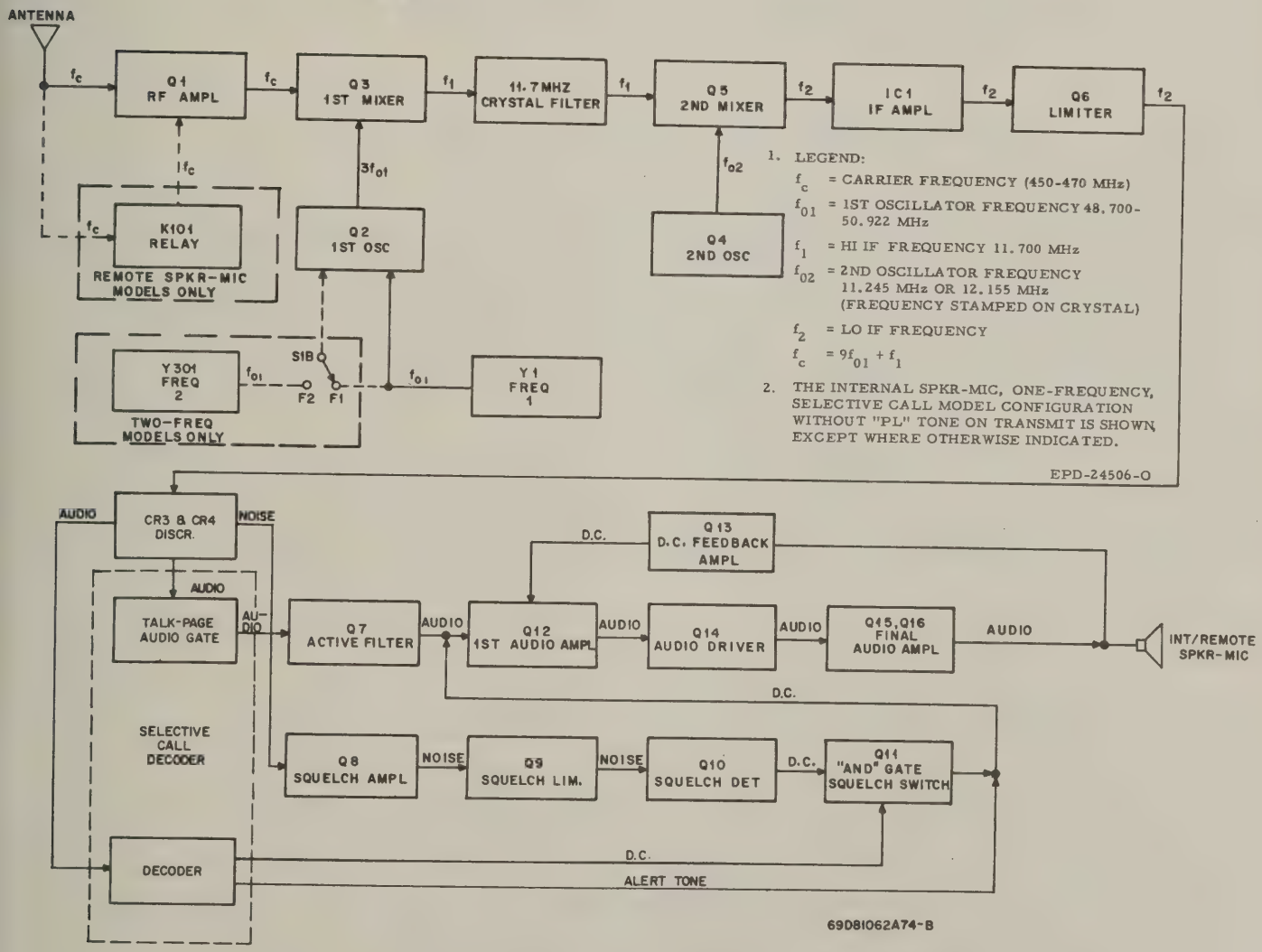


Figure 4. Typical Receiver Block Diagram

switch Q11 along with the dc signal from squelch detector Q10, the latter also at zero volts due to noise absence during coded tone reception. Q11 turns off, allowing the alert tone to be fed to first audio amplifier Q12. This allows an amplified alerting tone to be heard at the speaker.

(4) "Private-Line" Tone Encoder Refer to Figure 2 or 3 and the "Private-Line" Encoder Schematic Diagram

A feedback loop within the "PL" tone encoder is established when voltage from the transmitter is applied to reed driver Q601. Q601 shocks the "Vibrasponder" resonant reed into oscillation. The reed output is applied to class A biased feedback amplifier Q602, which through C603 feeds part of its output back to Q601. The frequency of oscillation is controlled by the resonant reed. The "PL" tone output is taken from the collector of Q602 and is applied to the transmitter IDC module. The amount of "PL" tone deviation is set by R608.

(5) Selective Call Decoder Refer to Figure 5 and the Selective Call Decoder Schematic Diagram

There are two types of pager models available: a single-code model and a dual-code model. The single-code model requires two "Vibrasponder" resonant reeds. The tone codes required to activate these reeds are designated A for the first tone and B for the second tone. Tone A is transmitted for one second followed within 400-milliseconds by three seconds of Tone B. In dual-code models, the first two reeds are normally used for individual paging and the second two (designated C and D) are used for group paging. The paging tones must appear in the proper sequence to provide a paging tone at the speaker (Refer to Selective Call Decoder DC Switching Waveforms).

The "Vibrasponder" reed is an electromechanical device whose vibrating mass is resonant at a particular frequency. If a tone is applied to the input coil at the reed's resonant frequency, the vibrating member will begin oscillating (damped oscillation), mechanically coupling the input signal to the output coil. Therefore, each reed can be considered to be a very narrow bandpass filter which passes only the desired paging tone to the decoder network.

Signals from the discriminator are coupled to a high input impedance emitter follower (Q401) which acts as a buffer stage to prevent discriminator loading. The reed driver (Q402) then amplifies the signal to the desired voltage level across the reeds. CR401 limits the voltage swing across the reeds to minimize voice and noise peaks at the reed's resonant frequency. If Tone A is the signal being sent, it will be present at the output of reed A and will be amplified by the class A biased tone amplifier (Q403) and coupled to the tone detector consisting of Q404 and Q405. With both tone detector transistors saturated, a dc voltage is

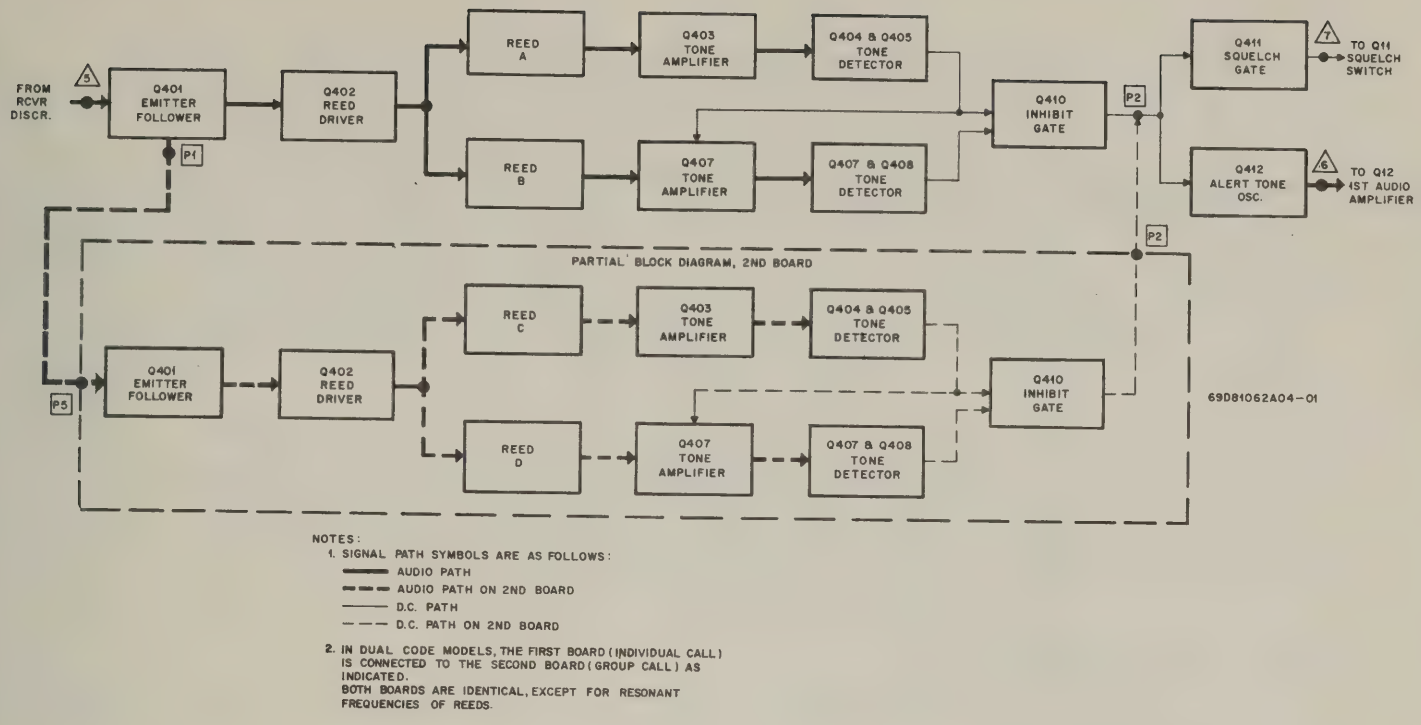


Figure 5. Selective Call Decoder Block Diagram

applied to the base of the inhibit gate (Q410) and to the base of channel B tone amplifier Q407 via R420. Tone B can be amplified by Q407 only after Q405 has saturated. This operation requires that Tones A and B be sent in the proper sequence. Q405 will remain on for approximately one and a half seconds after Tone A ends. During this period, Tone B may be amplified by Q407 and detected by Q408 and Q409. However, no bias can be applied to alert tone oscillator Q412 or squelch gate Q411 because the inhibit gate (Q410) is zero-biased. When Q405 turns off, Q410, Q411, and Q412 turn on and remain on until Tone B ends. The squelch gate (Q411) dc signal turns the receiver audio on through squelch switch Q11 and the signal from alert tone oscillator Q412 is fed to first audio amplifier Q12. The alert tone is heard at the speaker.

In dual code models, the reception and detection of tones C and D are identical to that of tones A and B in single-code models. Two single code boards are connected in parallel for dual-code capability (refer to Figure 5).

Voltage regulator Q406 insures that the decoder supply voltage will remain constant over variations in battery terminal voltage.

When the P-T switch is in the P position, CR407 of the talk-page audio gate network is zero-biased by the voltage applied at point (1) and no audio path exists between points (8) and (9) (refer to Receiver Schematic Diagram included herein). With the P-T switch in the T position, CR407 is forward-biased and audio proceeds unattenuated from point (8) to point (9) .

5. SELECTIVE CALL CODE SELECTION AND TONE IDENTIFICATION

The Selective Call "Handie-Talkie" Radio is used in a two-tone sequential signaling system. The first tone, designated tone A, is transmitted for one second. The second tone, designated tone B, is transmitted for three seconds. Each Selective Call "Handie-Talkie" Radio in the system responds to a unique combination of tones. This combination of tones is determined by "Vibrasponder" reeds installed in the "Handie-Talkie" radio (hereafter referred to as pager).

There are 60 unique tone frequencies from which Tones A and B may be selected. Each tone is assigned a code number. This number is usually referred to as the "Reed Code". For general code selection information, refer to attached Chart PEPF-769.

6. MAINTENANCE

a. Test Equipment

The TEST EQUIPMENT section presented in the accompanying instruction manual is applicable to the selective call models.

b. Test Procedure

NOTE

The TEST PROCEDURE subsection of the attached instruction manual is applicable, except refer to the printed circuit board details in this supplement for location of selective call and "PL" encoder components.

TO TEST DECODER CIRCUIT OPERATION

(1) Test Equipment Required

Motorola TEK-34A, (or equivalent) Tone Generator
Motorola S1333A, (or equivalent) Audio Synthesizer
Motorola S1318A, (or equivalent) FM Signal Generator

(2) Test Procedure (Using TEK-34A Tone Generator)

(a) Insert Motorola "Vibrasender" reeds (with frequencies corresponding to the decoder under test) into the Tone 1 and Tone 2 receptacles of the Tone Generator.

(b) Connect a test cable from the Tone Generator output to the Ext Mod (external modulation) receptacle of the FM Signal Generator.

(c) Connect the FM Signal Generator output to the rf input of the radio under test using the proper tune-up cable.

(d) Adjust the FM Signal Generator to the radio set frequency at 3.3 kHz deviation.

(e) Depress the Tone Generator TONE 1 pushbutton, hold down for 1 second, then release. Depress the Tone Generator TONE 2 pushbutton, hold down for 3 seconds, then release.

NOTE

There should be no marked time lapse between the release of the TONE 1 pushbutton and the depressing of the TONE 2 pushbutton; as the TONE 1 button is released, immediately depress the TONE 2 pushbutton.

(f) The radio should respond. If not, follow the procedure outlined in the Decoder Troubleshooting Chart of this manual.

(3) Test Procedure (Using S1333A Audio Synthesizer)

(a) Set the thumbwheel switches and the adjacent frequency multiplier switches to the desired tone frequencies.

(b) Set the Mode Switch to CONT A and adjust LEVEL A to the desired output voltage (sufficient to modulate the signal generator).

(c) Set the Mode Switch to CONT B and adjust LEVEL B to the desired output voltage (same as LEVEL A).

(d) Set the Mode Switch to BURST.

(e) Set the Cycle Switch to A and B.

(f) Set the Tone 1 Duration to 1 second. Set the Delay between pulses to 0.1 second. Set the Tone 2 Duration to 3.0 seconds.

(g) Connect the test cable from the Audio Synthesizer output jack to the Ext Mod (external modulation) receptacle of the FM Signal Generator.

(h) Connect the FM Signal Generator output to the rf input of the radio under test using the proper tune-up cable.

(i) Adjust the FM Signal Generator to the radio set frequency at 3.3 kHz deviation.

(j) Press the Cycle Clear pushbutton twice. The first time the button is actuated initiates the cycle, the second time prevents the unit from cycling again.

NOTE

Occasional circuit transients occurring during internal or external switching will turn on two or more of the light emitting diodes. Should this occur, clear the cycle by pressing the Clear/Cycle switch. When all lights are "off" press the Clear/Cycle switch to resume normal operation.

(k) The radio should respond. If not, follow the procedure outlined in the Decoder Troubleshooting Chart of this manual.

c. Disassembly Procedure

The test presented in the DISASSEMBLY PROCEDURE subsection in the attached manual is applicable. However, refer to Figure 6 for "Vibrasponder" reed location.

d. Disassembly Procedures (Advanced)

The DISASSEMBLY PROCEDURES (ADVANCED) subsection in the attached manual is applicable.

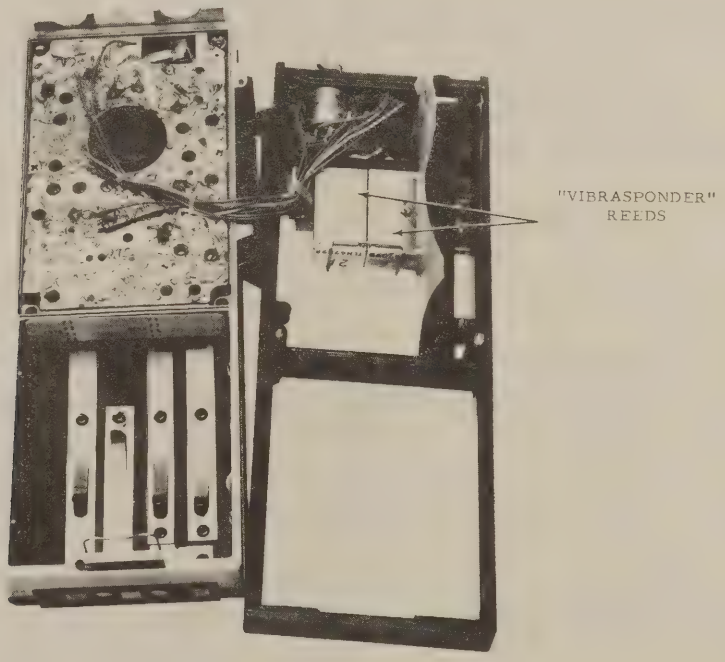


Figure 6. "Vibrasponder" Reed Location

e. Transmitter and Receiver Troubleshooting Chart

The text in the TRANSMITTER TROUBLESHOOTING CHART subsection, presented in the attached manual, is applicable. A RECEIVER TROUBLESHOOTING CHART is included in this supplement.

f. Decoder Troubleshooting Chart

The selective call DECODER TROUBLESHOOTING CHART presented herein will help isolate circuit functions in the decoder portion of the radio.

g. Transmitter Service Notes

The TRANSMITTER SERVICE NOTES subsection presented in the attached manual is applicable.

h. Receiver Stage Analysis

This subsection in the attached manual is fully applicable.

i. "Private-Line" Circuit Test Measurements

The interstage, reference voltages presented on the "Private-Line" Tone Encoder Schematic Diagram included in this supplement will aid the serviceman in localizing trouble in the "PL" circuitry, assuming that the transmitter is functioning properly.

j. Decoder Service Notes

The information presented in this supplement will aid the serviceman in troubleshooting the selective call decoder. The following DECODER MEASUREMENTS CHART gives approximate voltage measurements that should be expected for a properly operating decoder stage. Voltage readings which vary significantly from readings given in the chart may indicate trouble.

k. Repair Techniques

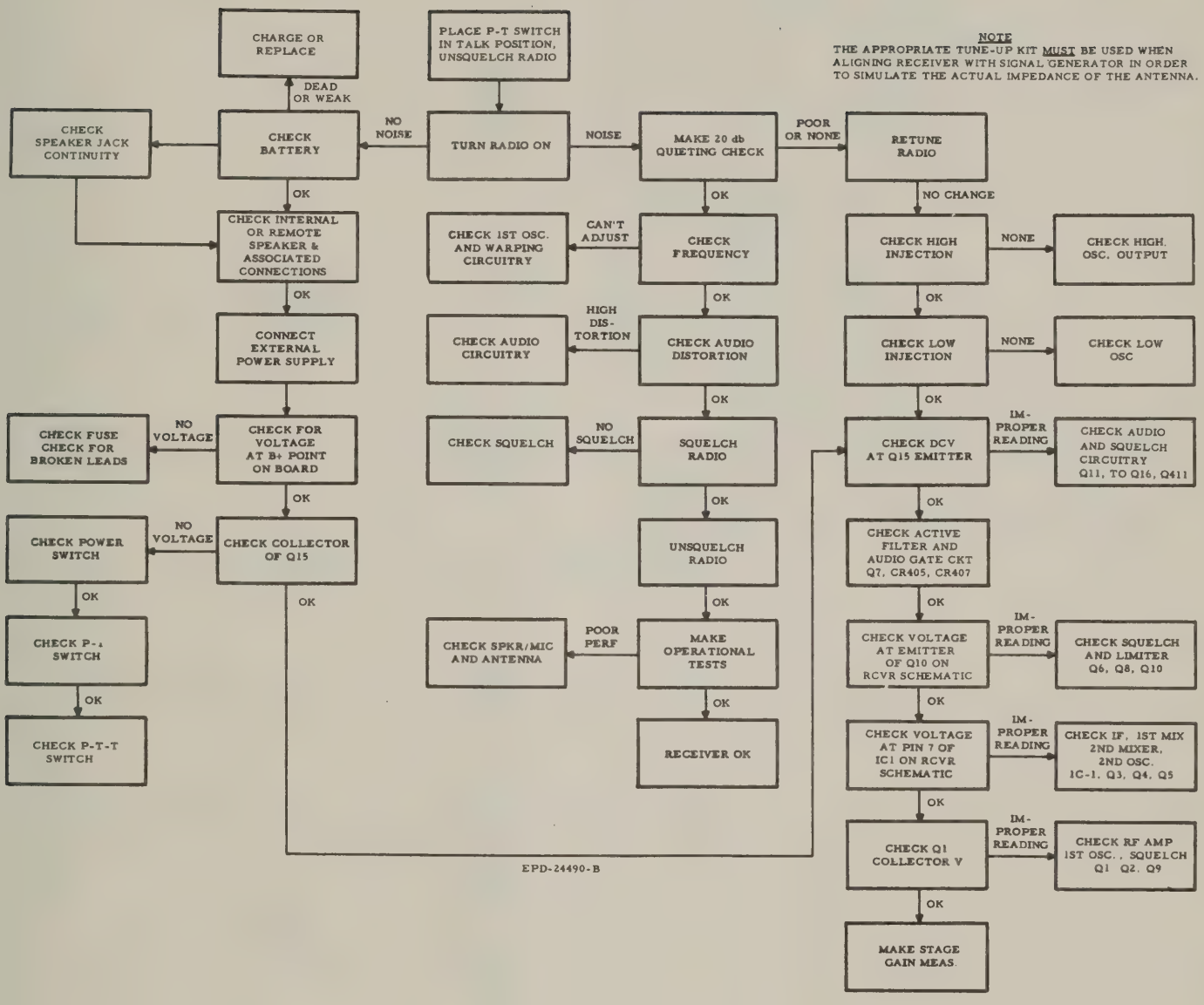
The REPAIR TECHNIQUES described in the attached instruction book are applicable to selective call models.

7. SERVICE CHARTS AND DIAGRAMS

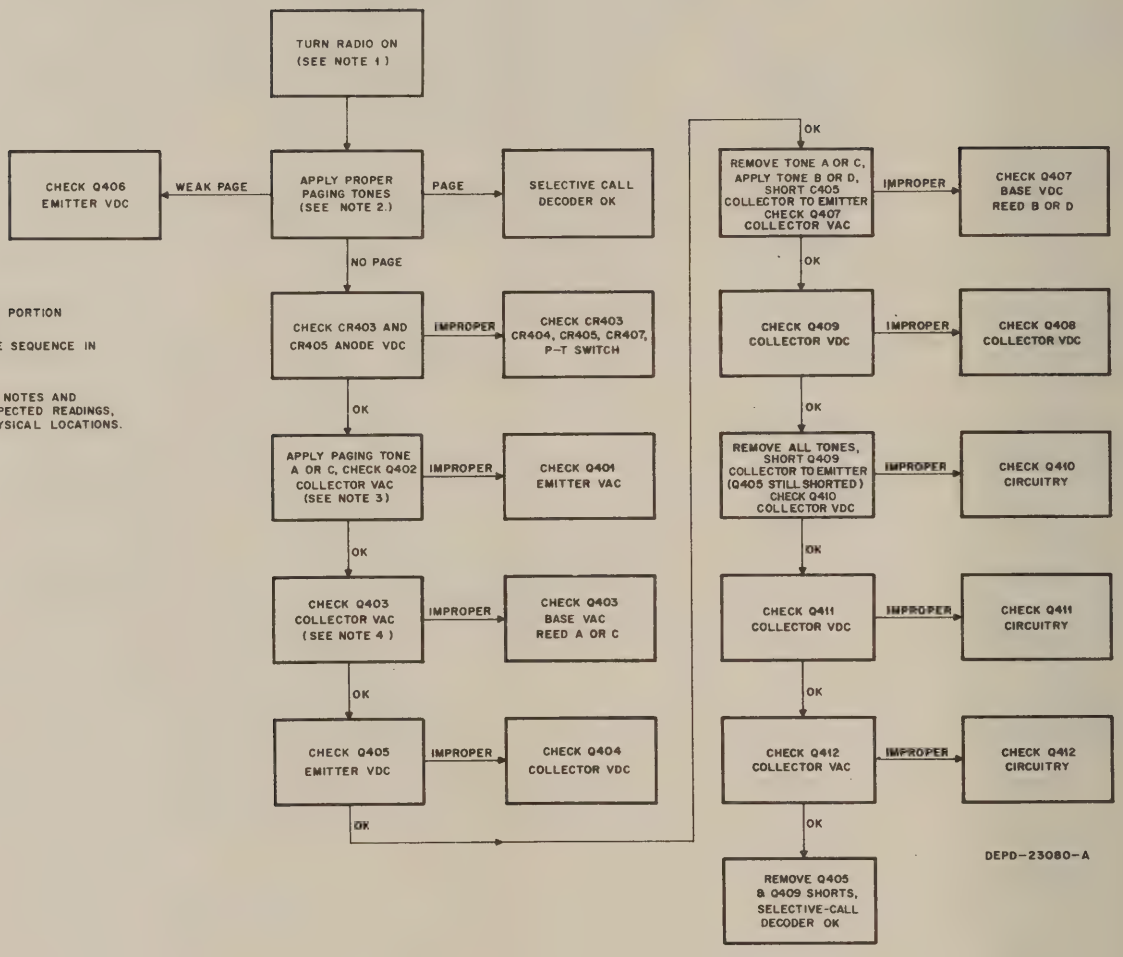
a. The TRANSMITTER ALIGNMENT PROCEDURE and "IDC". ADJUSTMENT described in the attached instruction manual are applicable to selective call models, however, the P-T switch must be set to the "talk" position.

b. The RECEIVER ALIGNMENT PROCEDURE described in the attached instruction manual is applicable to selective call models.

c. The diagrams included in this supplement replace those appearing in the attached instruction manual.



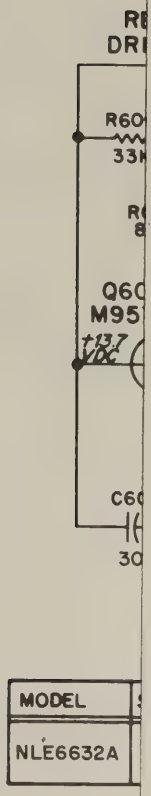
Receiver Troubleshooting Chart
Motorola No. DEPD-24490-B



NOTES:

1. IT IS ASSUMED THAT RECEIVER PORTION IS OPERATING PERFECTLY.
2. APPLY A AND B PAGING TONE SEQUENCE IN SINGLE-CODE MODELS.
3. REFER TO DECODER SERVICE NOTES AND SCHEMATIC DIAGRAM FOR EXPECTED READINGS, AND BOARD DETAILS FOR PHYSICAL LOCATIONS.

Decoder Troubleshooting Chart
Motorola No. DEPD-23080-O

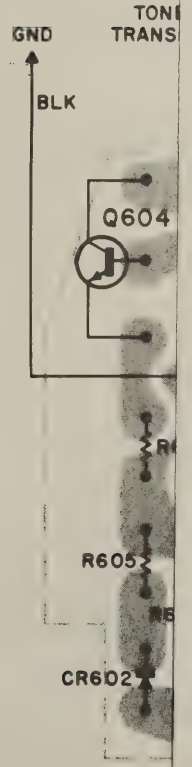


PARTS LIST

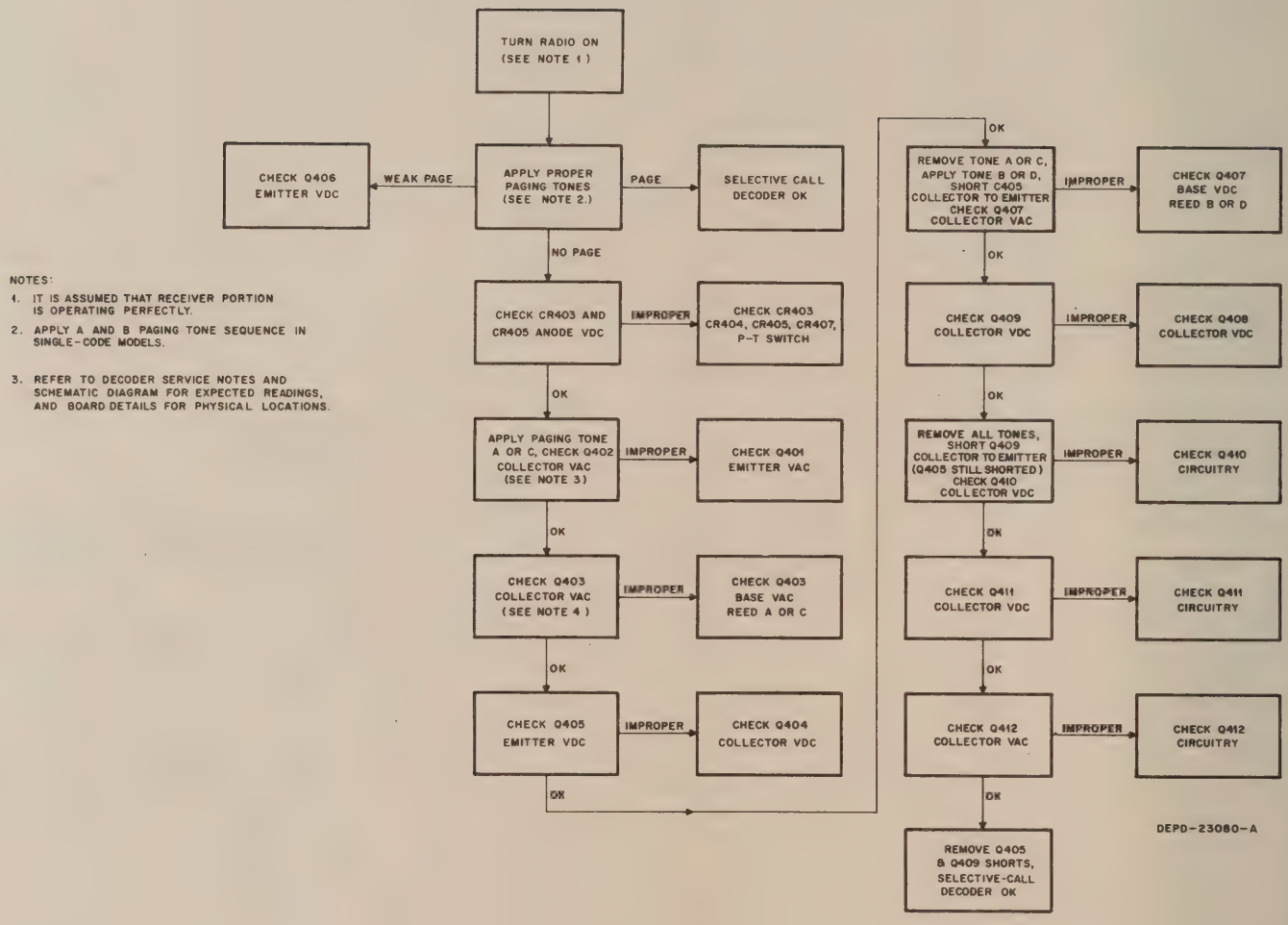
NLE6632A "Private-Line" Tone Encoder PLF-354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 75 V; unless stated
C601, 605, 609	21K864521	30 pF; N750
C602	23D83441B26	15 ±20%; 20 V
C603, 608	23D83441B15	1.0 ±20%; 35V
C604	21C82213E03	0.0055 +100-0%
C606	23D83441B12	2.2 ±20%; 15 V
		SEMICONDUCTOR DEVICE, Diode: (SEE NOTE)
CR601, 602	48C83654H01	silicon
		COIL, RF:
L601, 602, 603	24C82723H04	choke; .29 uH
		TRANSISTOR: (SEE NOTE)
Q601, 602, 604	48R869570	NPN; type M9570
		RESISTOR, Fixed: ∩ ±10%; 1/8W
R601	6S185B97	33 k
R602	6S185B78	820
R603, 606	6S185C02	68 k
R604	6S185B92	12 k
R605	6S185B68	120
R607	6S185B64	56
R608	18C82876B07	var; 50 k ±20%; 0.05 W
R609	6S185B86	3.9 k
R610	6S185B71	220
R611, 613	6S185B91	10 k
R612	6S185C01	56 k
R614	6S185B89	6.8 k
NONREFERENCED ITEMS		
	14C83786H01	SOCKET, Base
	15B83785H01	COVER, Socket
	39B82865G01	CONTACT, (4 req'd)
	7A83783H01	BRACKET, REED Mtg.

NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.



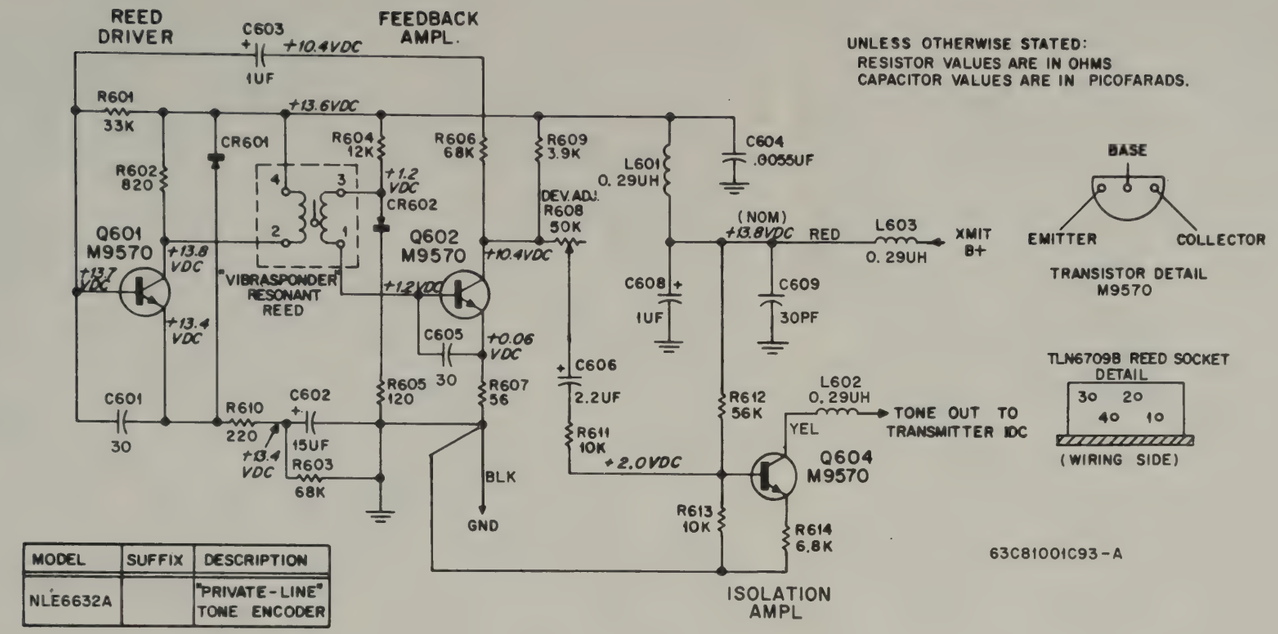
NLE6632A "Private-Line" Encoder
Schematic Diagram and
Printed Circuit Board Detail
Motorola No. PEPF-1198-A
8/14/74 - JS



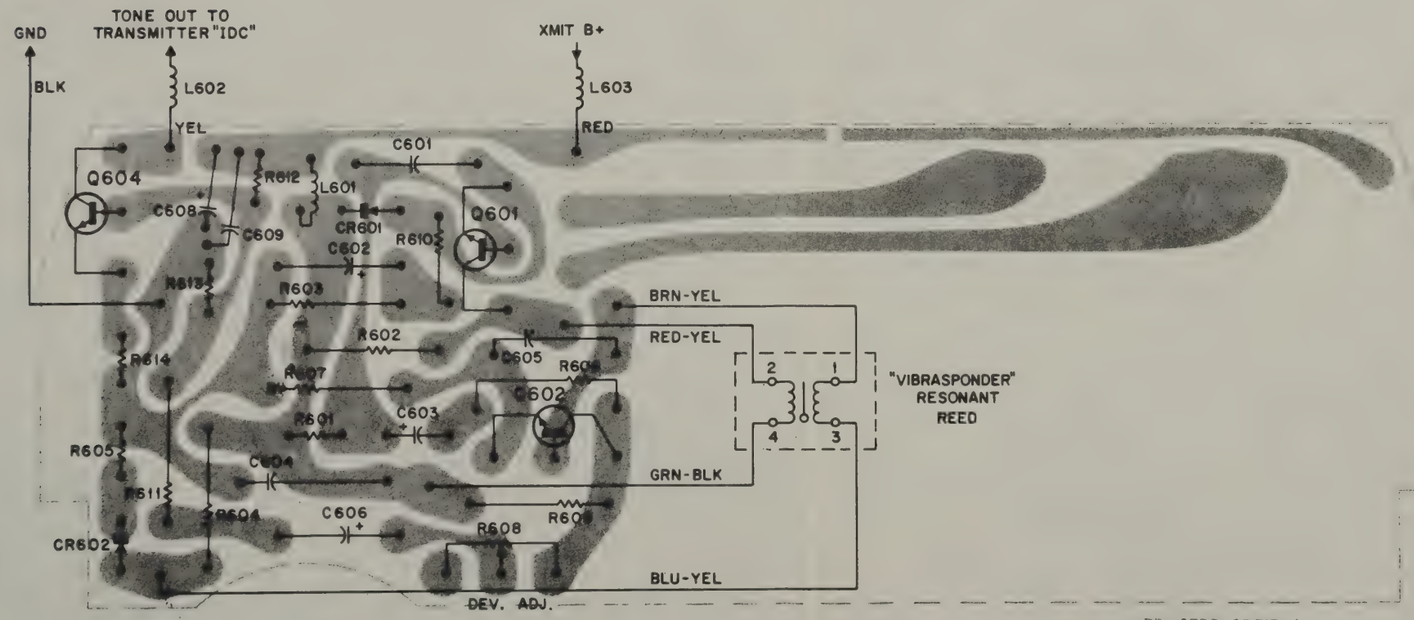
NOTES:

1. IT IS ASSUMED THAT RECEIVER PORTION IS OPERATING PERFECTLY.
2. APPLY A AND B PAGING TONE SEQUENCE IN SINGLE-CODE MODELS.
3. REFER TO DECODER SERVICE NOTES AND SCHEMATIC DIAGRAM FOR EXPECTED READINGS, AND BOARD DETAILS FOR PHYSICAL LOCATIONS.

Decoder Troubleshooting Chart
Motorola No. DEPD-23080-O



MODEL	SUFFIX	DESCRIPTION
NLE6632A		"PRIVATE-LINE" TONE ENCODER



PARTS LIST

NLE6632A "Private-Line" Tone Encoder PLF-354-O

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uF ±10%; 75 V; unless stated
C601, 605, 609	21K864521	30 pF; N750
C602	23D83441B26	15 ±20%; 20 V
C603, 608	23D83441B15	1.0 ±20%; 35V
C604	21C822113E03	0.0055 +100-0%
C606	23D83441B12	2.2 ±20%; 15 V
		SEMICONDUCTOR DEVICE, Diode: (SEE NOTE)
CR601, 602	48C83654H01	silicon
		COIL, RF:
L601, 602, 603	24C82723H04	choke; .29 uH
		TRANSISTOR: (SEE NOTE)
Q601, 602, 604	48R869570	NPN; type M9570
		RESISTOR, Fixed: Ω ±10%; 1/8W
R601	6S185B97	33 k
R602	6S185B78	820
R603, 606	6S185C02	68 k
R604	6S185B92	12 k
R605	6S185B68	120
R607	6S185B64	56
R608	18C82876B07	var; 50 k ±20%; 0.05 W
R609	6S185B86	3.9 k
R610	6S185B71	220
R611, 613	6S185B91	10 k
R612	6S185C01	56 k
R614	6S185B89	6.8 k
NONREFERENCED ITEMS		
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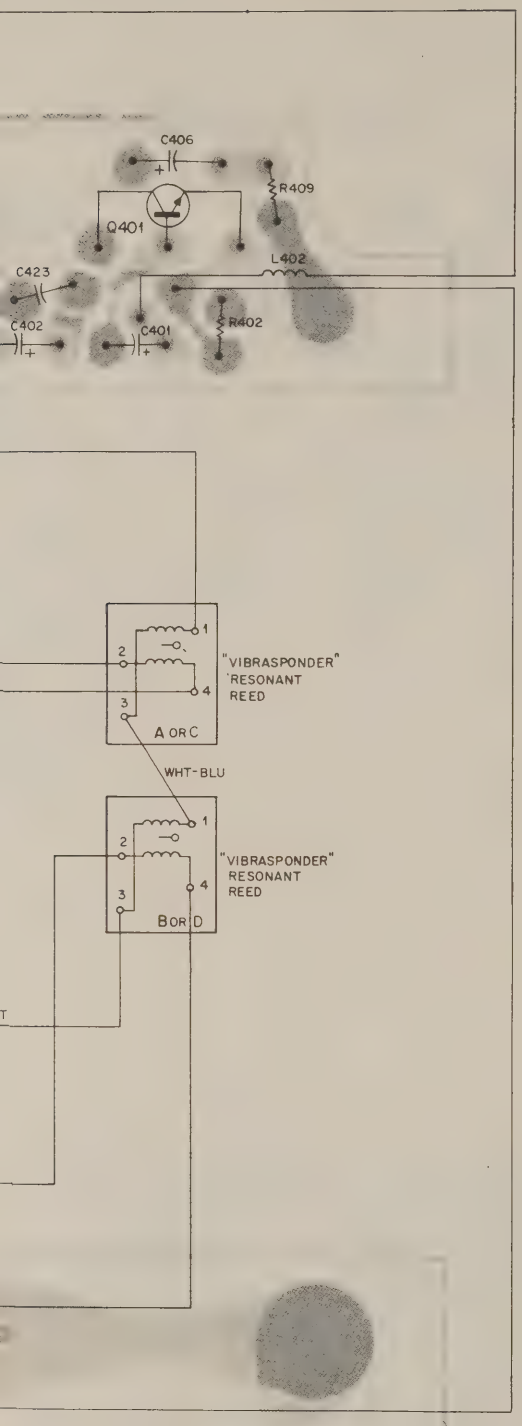
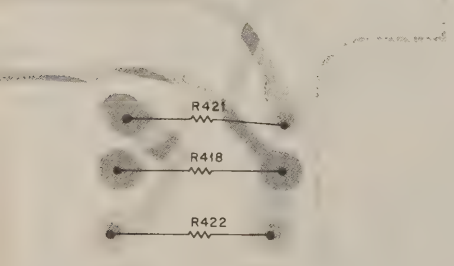
	15B83785H01	COVER, Socket
	39B82865G01	CONTACT, (4 req'd)
	7A83783H01	BRACKET, REED Mtg.

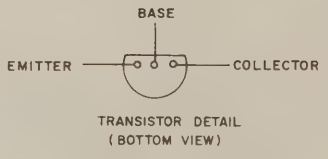
NOTE:
Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

NLE6632A "Private-Line" Encoder
Schematic Diagram and
Printed Circuit Board Detail
Motorola No. PEPF-1198-A
8/14/74 - JS

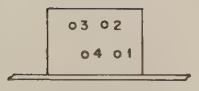




OL-EEPD-25345-G



TRANSISTOR DETAIL
(BOTTOM VIEW)

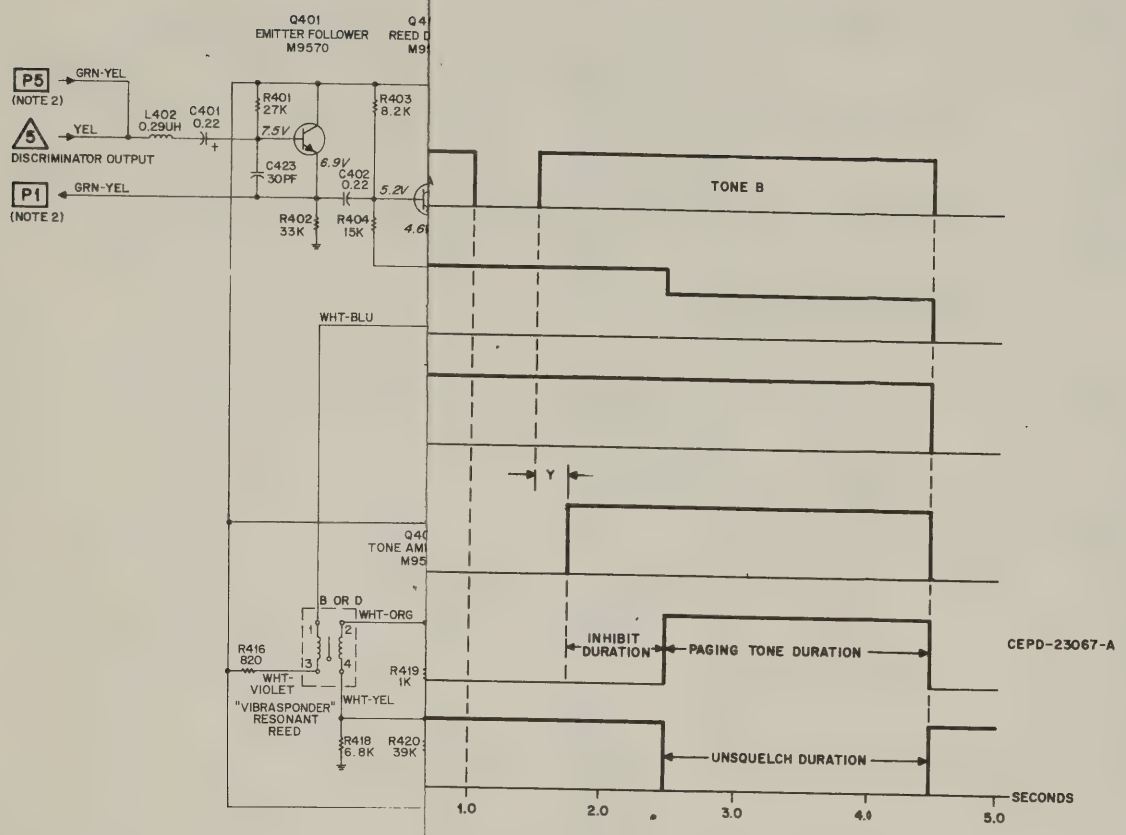


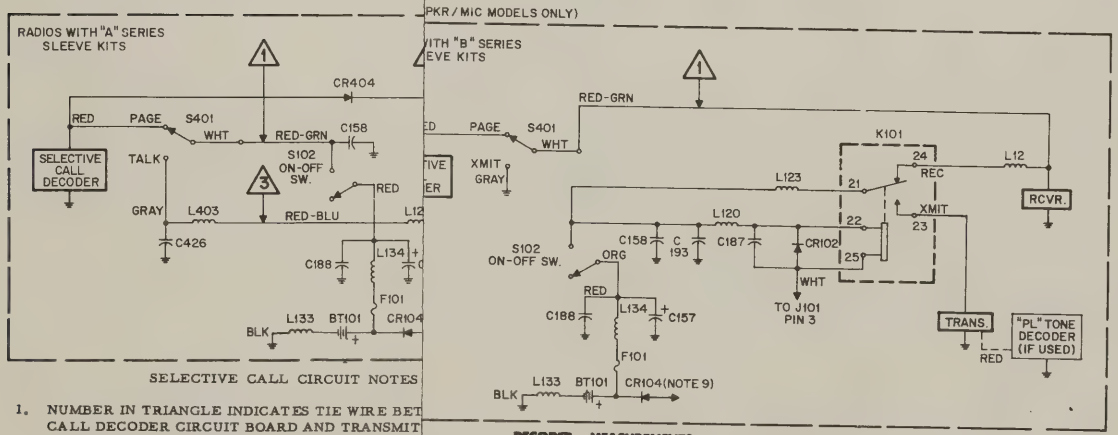
REED SOCKET DETAIL
(WIRING SIDE)

NOTES:

1. NUMBER IN TRIANGLE INDICATES TIE WIRE BETWEEN SELECTIVE CALL DECODER CIRCUIT BOARD AND TRANSMITTER-RECEIVER CIRCUIT BOARD. NUMBER IN SQUARE INDICATES TIE WIRE BETWEEN TWO SELECTIVE CALL DECODER CIRCUIT BOARDS (4-REED MODELS).
2. IN 4-REED MODELS, TWO 2-REED BOARDS ARE PARALLELED AT POINTS [P2], [P3] AND [P4]. POINT [P1] ON INDIVIDUAL CALL BOARD IS CONNECTED TO POINT [P5] ON GROUP CALL BOARD BY A GRN-YEL LEAD. [P5] OR (5) IS AT THE NEGATIVE SIDE OF C401.
3. CUT JU401 FOR LOW LEVEL ALERT TONE.
4. (8), (9) NETWORK REPLACES INPUT COUPLING CAPACITOR TO ACTIVE FILTER IN RECEIVER.
5. (A) INDICATES ITEM IS MOUNTED ON SOLDER SIDE.

EPD-24509-C





SELECTIVE CALL CIRCUIT NOTES

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2. IN 4-REED MODELS, TWO 2-REED BOARDS ARE I AT POINTS P2, P3, AND P4. POINT P1 CALL BOARD IS CONNECTED TO POINT P5 ON C BOARD BY A GRN-YEL LEAD.
3. CUT JU401 FOR LOW LEVEL ALERT TONE.
4. 8, 9 NETWORK REPLACES C58 IN RECEIVER.
5. UNLESS OTHERWISE STATED, CAPACITANCES AR FARADS (UF) AND RESISTANCES ARE IN OHMS (K
6. DC VOLTAGES ARE TAKEN WITH A MOTOROLA D OR EQUIVALENT, AND ARE REFERENCED TO CH (B-).
7. REFER TO DC DISTRIBUTION DIAGRAMS FOR 1 INTERCONNECTIONS.
8. WHERE TWO REFERENCE VOLTAGES ARE SHOWN BOTTOM VALUE IS FOR ACTIVE-PAGE MODE OF TOP FOR STANDBY-PAGE OR STANDARD MODES. MODE, UNIT OPERATES AS A TWO-WAY RADIO; INOPERATIVE.
9. CR104 IS FOR POLARITY PROTECTION -- CONNE CONTACTS.

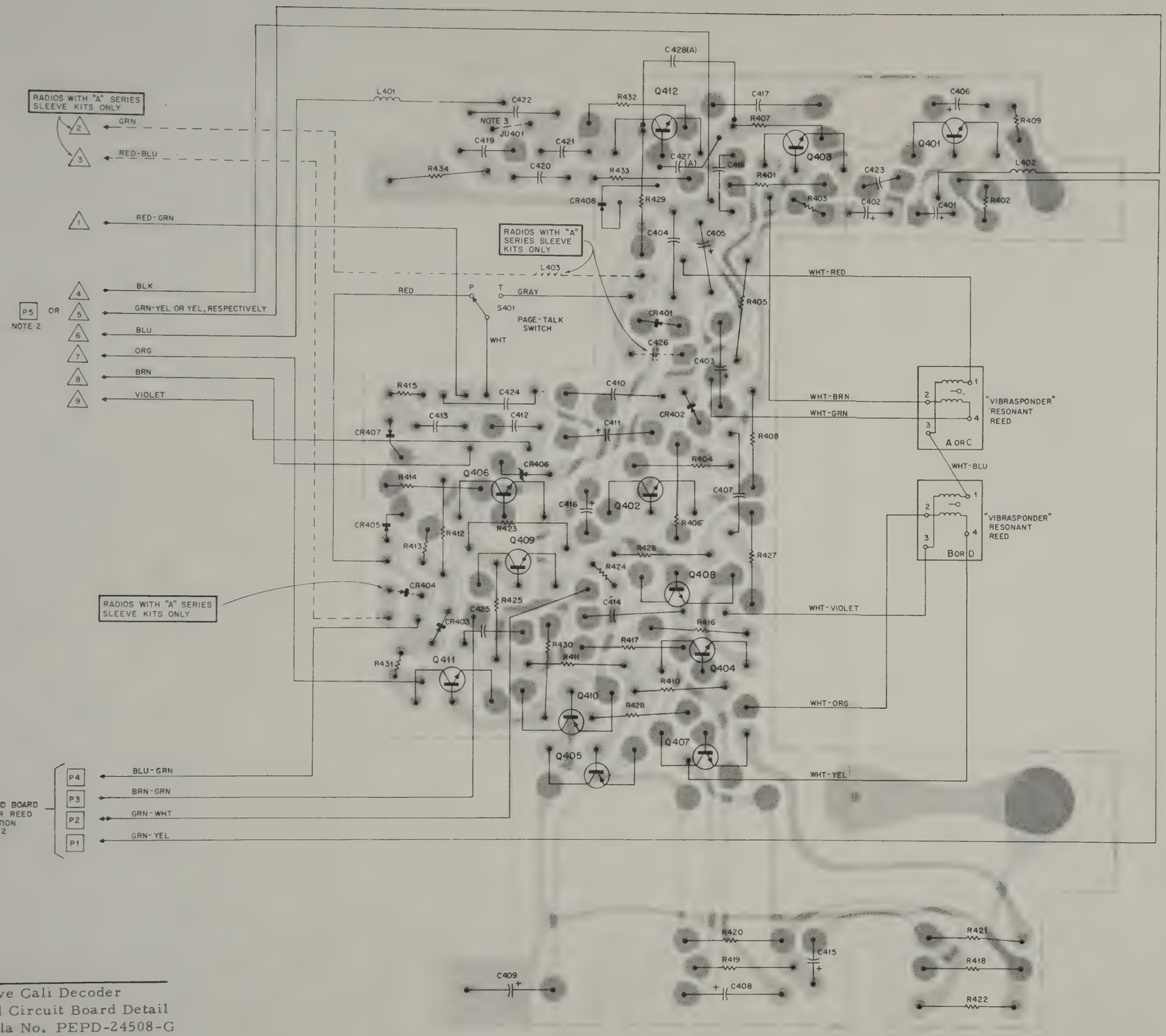
DECODER MEASUREMENTS CHART

NOTES

emove the YEL lead 5 from the receiver board.
onnect the Motorola S1067A Transistorized Audio Oscillator, or an quivalent audio oscillator capable of generating 300 to 1100 Hertz, to e YEL lead through a 47k ohm series resistor.
et the frequency and voltage according to the following chart. The put voltage is measured at the junction of the 47k ohm resistor and e YEL lead.
oltage readings are referenced to ground unless otherwise indicated nd are taken with a Motorola Transistorized AC Voltmeter and otorola DC Multimeter or their equivalents.
ll measurements are to be made with +14.5 volts dc input and the -T (Page-Talk) switch in the P position.

VIOUS REVISIONS AND PARTS LIST
WN ON BACK OF THIS DIAGRAM

ctive Call Decoder & D. C. Distribution
matic Diagrams
rola No. PEPF-768-A
73 - JS



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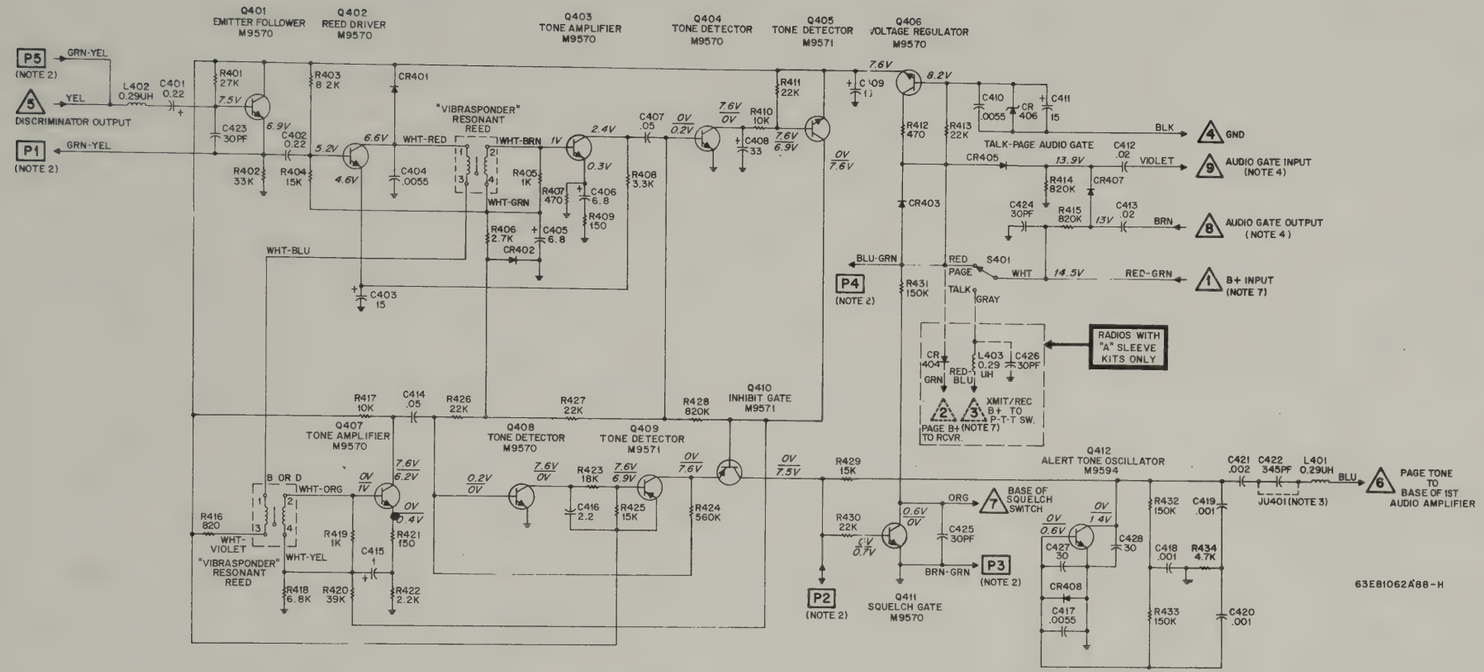
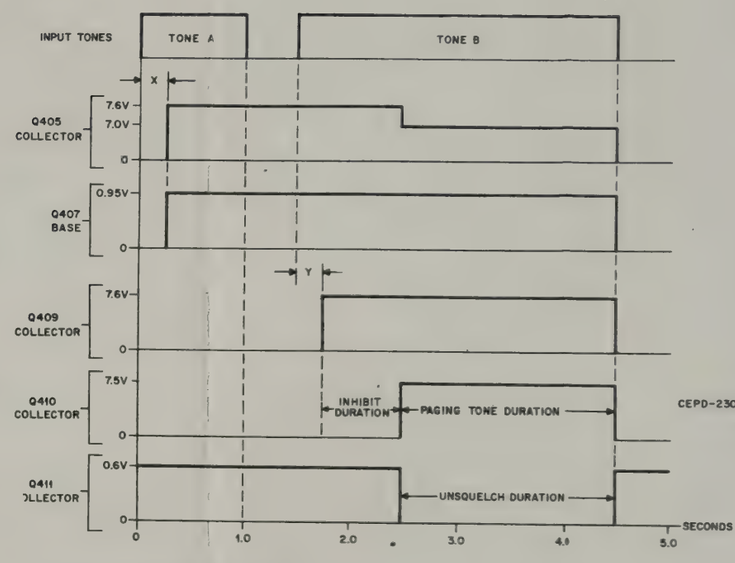
3. CUT JU401 FOR LOW LEVEL ALERT TONE.
4. △3, △4 NETWORK REPLACES INPUT COUPLING CAPACITOR TO ACTIVE FILTER IN RECEIVER.
5. (A) INDICATES ITEM IS MOUNTED ON SOLDER SIDE.

EPD-24509-C

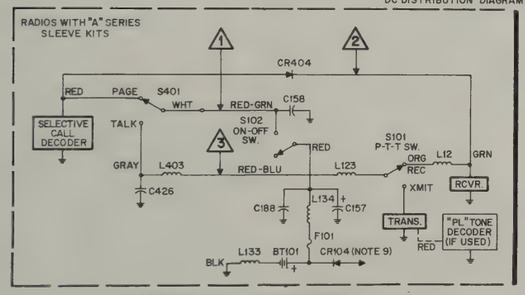
Selective Call Decoder
Printed Circuit Board Detail
Motorola No. PEPD-24508-G
8/12/74 - JS

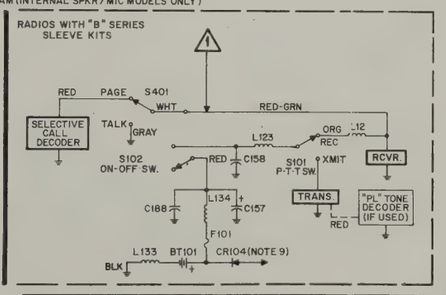
OL-EEPD-25345-G





DC DISTRIBUTION DIAGRAM (INTERNAL SPKR / MIC MODELS ONLY)





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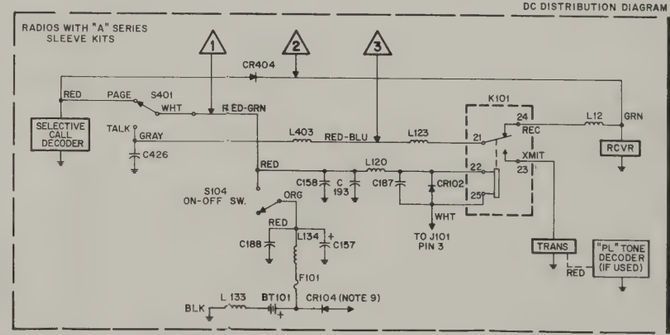
3. CUT JU401 FOR LOW LEVEL ALERT TONE.
4. 8, 9 NETWORK REPLACES C58 IN RECEIVER.
5. UNLESS OTHERWISE STATED, CAPACITANCES ARE IN MICROFARADS (UF) AND RESISTANCES ARE IN OHMS (K = 1000 OHMS).
6. DC VOLTAGES ARE TAKEN WITH A MOTOROLA DC MULTIMETER, OR EQUIVALENT, AND ARE REFERENCED TO CHASSIS GROUND (B-).
7. REFER TO DC DISTRIBUTION DIAGRAMS FOR 1, 2, AND 3 INTERCONNECTIONS.
8. WHERE TWO REFERENCE VOLTAGES ARE SHOWN, i.e., $\frac{0.2}{0}$ V, BOTTOM VALUE IS FOR ACTIVE-PAGE MODE OF OPERATION, TOP FOR STANDBY-PAGE OR STANDARD MODES. IN STANDARD MODE, UNIT OPERATES AS A TWO-WAY RADIO; PAGER IS INOPERATIVE.
9. CR104 IS FOR POLARITY PROTECTION -- CONNECT TO CHARGING CONTACTS.

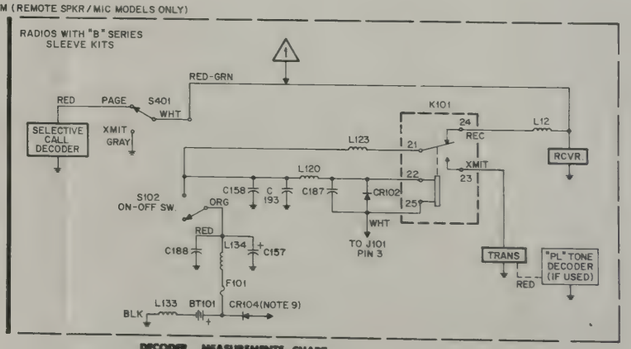
EPD-24510-C

FREQUENCY	VOLTS INPUT	INPUT TO	OUTPUT AT	TYPICAL READING	REMARKS
1000 Hertz	0.15V ac (-14 dBm)	YEL lead (input to decoder)	Base of Q402	-19 dBm (0.085V)	
			Collector of Q402	+5 dBm (1.5V)	
Frequency of "Vibrasponder" unit in socket A			Base of Q403	-21 dBm (0.066V)	Adjust audio oscillator frequency to peak this reading
			Collector of Q403	+3 dBm (1.1V)	
			Base of Q404	+3 dBm (1.1V)	
			Base of Q407	1.0V dc	This checks saturation of Q405 with first trigger on.
SHORT COLLECTOR TO EMITTER OF Q405					
Frequency of "Vibrasponder" unit in socket B	0.15V ac (-14 dBm)	YEL lead (input to decoder)	Collector of Q407	+1.5 dBm (0.95V)	Adjust audio oscillator frequency to peak this reading
			Base of Q408	+1.5 dBm (0.95V)	
REMOVE SHORT FROM Q405, SHORT 7.6 VOLT SUPPLY BUS (EMITTER OF Q406) TO COLLECTOR OF Q410					
	Not required		Collector of Q412	+1.0 dBm (0.85V)	Checks page tone output.

EPF-763-A

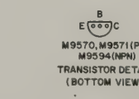
DC DISTRIBUTION DIAGRAM (REMOTE SPKR / MIC MODELS ONLY)

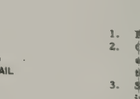




SELECTIVE CALL SLEEVE KITS

MODEL	SUFFIX	DESCRIPTION
NLN8020A	6	2-REED (CARR. SQ)
NLN8020B		
NLN8021A	6	4-REED (CARR. SQ)
NLN8021B		
NLN8022A	6	2-REED ("PL")
NLN8022B		
NLN8023A	6	4-REED ("PL")
NLN8023B		
NLN8220A		2-REED
NLN8220B		SILVERIZED ("PL")
NLN8221A		2-REED
NLN8221B		SILVERIZED (CARR. SQ)





WAVEFORM NOTES

1. REED RESPONSE TIMES ARE AS FOLLOWS:
   X = TIME NECESSARY FOR REED A TO START
   Y = TIME NECESSARY FOR REED B TO START
2. TIMING RELATIONSHIPS FOR INPUT TONES C AND D (H23FFN' & H24FFN' SERIES RADIOS ONLY) ARE IDENTICAL TO THOSE FOR TONES A AND B, RESPECTIVELY.

EPD-23071-B

DECODER MEASUREMENTS CHART

NOTES

1. Remove the YEL lead 5 from the receiver board.
2. Connect the Motorola S1067A Transistorized Audio Oscillator, or an equivalent audio oscillator capable of generating 300 to 1100 Hertz, to the YEL lead through a 47k ohm series resistor.
3. Set the frequency and voltage according to the following chart. The input voltage is measured at the junction of the 47k ohm resistor and the YEL lead.
4. Voltage readings are referenced to ground unless otherwise indicated and are taken with a Motorola Transistorized AC Voltmeter and Motorola DC Multimeter or their equivalents.
5. All measurements are to be made with +14.5 volts dc input and the P-T (Page-Talk) switch in the P position.

PREVIOUS REVISIONS AND PARTS LIST SHOWN ON BACK OF THIS DIAGRAM

Selective Call Decoder & D. C. Distribution
Schematic Diagrams
Motorola No. PEPF-768-A
2/9/73 - JS

MOTOROLA PART NO.	DESCRIPTION
NONREFERENCED ITEMS	
5E05836A01	FRAME (NLN8020A & B, 8021A & B)
or 15E84045H01	FRAME (NLN8022A & B)
or 15E05838A01	FRAME (NLN8023A & B)
or 15E05842A01	FRAME (NLN8220A & B)
or 15E05840A01	FRAME (NLN8221A & B)
12A84349H01	GASKET, Switch
1A82453E03	WASHER, Nylon; 2 req'd
1A82653D03	NUT, Special
16C84135H01	KNOB, Wing
1A83174C02	SETSCREW
4C84729H01	INSULATOR (NLN8020A & B, 8021 A & B)
or 14C84729H02	INSULATOR (NLN8022A & B, 8023 A & B)
or 14C84729H05	INSULATOR (NLN8220A & B, 8221A & B)
2B82172J01	GASKET
3B84073H01	BUSHING; 2 req'd (NLN8020A & B, 8021A & B, 8221A & B)
3B84073H03	BUSHING; 2 req'd (NLN8020A & B, 8021A & B, 8221A & B)
3B84073H03	BUSHING; 4 req'd (NLN8022A & B, 8023A & B, 8220A & B)
7B84258H01	PAD, Sleeve (NLN8021A & B only)
3B84228H01	INSERT, Antenna (NLN8020A & B, 8221A & B only)
1B84727H01	CONTACT, Spring; 2 req'd

rdware Kit (One-Freq. C.S.)
rdware Kit (Two-Freq. C.S.)
rdware Kit (One-Freq. "PL")
rdware Kit (Two-Freq. "PL") EPD-24587-A

MOTOROLA PART NO.	DESCRIPTION
	CAPACITOR, fixed:
K864521	30 pF ±10%; 75V; N750
	COIL:
D82723H18	choke, 85 nH; remote speaker-mic models only; p/o xmtr
D82723H18	choke, 85 nH; internal speaker-mic models only; p/o xmtr
D82723H04	choke, 0.29 uH; p/o xmtr
ONREFERENCED ITEMS	
D05484A02	ESCUTCHEON (NLN8027B, NLN8029B)
13D05484A03	ESCUTCHEON (NLN8028B
13D05484A13	ESCUTCHEON (NLN8030B
B83573H11	KNOB, Control (except NLN8030B)
83174C02	SCREW, Set; 4-40 x 1/8
B82423B07	PAD, Rubber (NLN8029B, NLN8030B)
A83562H02	PAD, Rubber; (2 req'd)
B84763H01	KNOB, Control (NLN8030B)
C82591C12	PIN, Roll (NLN8030B)

odes and transistors must be ordered by number only for optimum performance.

1. General Encoding Method

The following information is included for reference only and may not apply to early Motorola paging systems. Use the appropriate encoder or terminal instruction manual for detailed encoding instructions.

The relationship between the "pager code" and the "Vibrasponder" reeds installed is established by the general encoding method. One or two three-digit code numbers are stamped on the code identification label. In single code models only one code number will appear which is usually for individual calling. In dual code models two code numbers will appear; one for individual calling, and the other for group calling.

The 60 paging tone frequencies are divided into six groups of ten tones each. These groups are numbered and designated Tone Group 1, Tone Group 2, etc.. Table 2 shows the tone codes and frequencies.

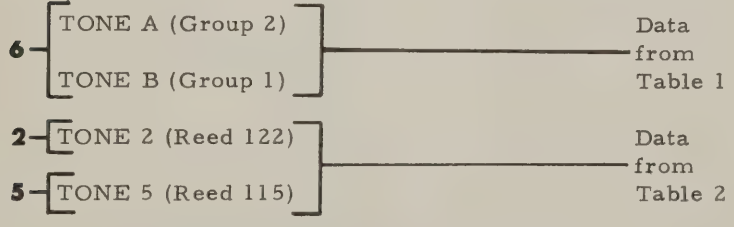
The first digit of the three-digit pager code determines the groups from which Tone A and Tone B will be selected. The tone groups indicated for each first digit are shown in Table 1. The next two digits of the pager code are the specific tones selected from the groups indicated in Table 1, for Tones A and B respectively.

To determine which tone frequencies or reed codes are associated with a given pager code, proceed as follows: look up the first digit of the pager code in Table 1. The groups for Tones A and B will be indicated. Refer to Table 2 and, in the group shown in the previous table for Tone A, the frequency and reed code for Tone A will be indicated on the line corresponding to the second digit of the pager code. The reed code and frequency for Tone B, will be found in the group determined for Tone B, on the line corresponding to the third digit of the pager code.

EXAMPLE I: Pager 625 - According to Table 1, the first digit of this pager (6) indicates that Tone A will be selected from Tone Group 2, and Tone B will be selected from Tone Group 1. The second digit indicates that tone 2 of group 2 will be used for Tone A, and the third digit shows tone 5 of group 1 for Tone B. This unit will have the following reeds installed:

Pager Code 625 -

Tone A - Reed Code 122, Frequency 634.5 Hz.
Tone B - Reed Code 115, Frequency 433.7 Hz.



2. Code Type Assignment Encoding Method

This encoding method has been devised to accommodate the large number of pagers used in high capacity paging systems such as the L08 Encoder or the L09 Dial Interconnected Paging Terminal. Pagers encoded by this method are assigned a letter prefix. This prefix is the "Code Type" designation. In the general encoding method, the relationship between the first digit of the pager code and the groups selected is arbitrary. In the code assignment method, the selected groups depend on the system code type. In essence, each code type column in this table is used in the same way as Table 1 was used in the general encoding method. In the column for the pager prefix, on the line corresponding to the first digit of the pager code, will be located the tone groups from which Tones A and B will be selected. Table 2 and the second and third digits of the pager code will determine the exact reed codes as outlined in Paragraph 1.

REVISIONS

CHASSIS AND SUFFIX NO.	REF. SYMBOL	CHANGE	LOCATION
NLN8020A-1 NLN8021A-1 NLN8022A-1 NLN8023A-1	Q412	WAS 48R869547	Q412
	CR408	ADDED 48C82363E03	Q412 BASE
NLN8020A-2 NLN8021A-2 NLN8022A-2 NLN8023A-2	L401	ADD 24D82723H04 0.29 uH	C422 BLU LEAD △
	C427	ADDED 50 pF	Q412 BASE
	C428		Q412 COLLECTOR
NLN8020A-3 NLN8021A-3 NLN8022A-3 NLN8023A-3	C423, 424, 425, 426	WERE 21K861436, 100 pF	PARTS LIST
NLN8020A-4 NLN8021A-4 NLN8022A-4 NLN8023A-4	L402	ADDED 1.2 uH	Q401 BASE
	C429	ADDED 100 pF	
	L402	REMOVE 1.2 uH	Q401 BASE
	C429	REMOVE 100 pF	
NLN8020A-5 NLN8021A-5 NLN8022A-5 NLN8023A-5	L403	ADDED	BETWEEN TIE POINT △ AND JUNCTION OF S401 AND C426
NLN8020A-6 NLN8021A-6 NLN8022A-6 NLN8023A-6	L402	ADDED	Q401 BASE

PARTS LIST

NLN8020A, B 2 Reed Selective Call Sleeve Kit (C.S.)
NLN8021A, B 4 Reed Selective Call Sleeve Kit (C.S.)
NLN8022A, B 2 Reed Selective Call Sleeve Kit ("PL")
NLN8023A, B 4 Reed Selective Call Sleeve Kit ("PL")
NLN8220A, B 2 Reed Selective Call Sleeve Kit ("PL")
NLN8221A, B 2 Reed Selective Call Sleeve Kit (C.S.) EPD-24588-E

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
		CAPACITOR, fixed: uf unless stated
C401, 402	23D82397D06	0.22; 35 v
C403, 409, 411	23D82397D17	15 ±20%; 20 v
C404, 410, 417	21C82213E03	0.0055; 75 v
C405, 406	23D82397D09	6.8 ±20%; 10 v
C407, 414	21D84008H13	0.05 ±20%; 12 v
C408	23D82397D18	33 ±20%; 10 v
C412, 413	21D83068E01	0.02 ±20%; 12 v
C415	23D82397D07	1; 20 v
C416	23D82397D19	2.2; 10 v
C418, 419, 420	21D82213E08	0.001; 100 v
C421	21K861442	0.002; 75 v
C422	21K861439	345 pf; N2200
C423, 424, 425, 426 427, 428	21K864521	30 pF +30-10%; 75 V; N750 (C426 used on "A" Sleeve Kits only)
		SEMICONDUCTOR DEVICE; diode: SEE NOTE
CR401, 402	48K855216	germanium
CR403, 404, 405, 407	48C82392B03	silicon (CR404 used on "A" sleeve kits only)
CR406	48C82256C08	ZENER, silicon; 8 v
CR408	48C82363E03	silicon
L401, 402, 403	24D82723H04	COIL, RF choke; 0.29 uH (L403 used on "A" Sleeve Kits only)
		TRANSISTOR: SEE NOTE
Q401, 402, 403, 404, 406, 407, 408, 411	48R869570	N-P-N; type M9570
Q405, 409, 410	48R869571	P-N-P; type M9571
Q412	48R869594	N-P-N; type M9594
		RESISTOR, fixed: ±10%; 1/8 w unless stated
R401	6S185B96	27K
R402	6S185B97	33K
R403	6S185B90	8.2K
R404, 425, 429	6S185B93	15K
R405, 419	6S185B79	1K
R406	6S185B84	2.7K
R407, 412	6S185B75	470
R408	6S185B85	3.3K
R409, 421	6S185B69	150
R410, 417	6S185B91	10K
R411, 413, 426, 427, 430	6S185B95	22K
R414, 415, 428	6S185C15	820K
R416	6S185B78	820
R418	6S185B89	6.8K
R420	6S185B98	39K
R422	6S185B83	2.2K
R423	6S185B94	18K
R424	6S185C13	560K
R431, 432, 433	6S185C06	150K
R434	6S185B87	4.7K
		SWITCH:
S401	40C84350H01	single pole, 2 position, subminiature, non-shorting rotary switch

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
	NONREFERENCED ITEMS	
	15E05836A01	FRAME (NLN8020A & B, 8021A & B)
	or 15E84045H01	FRAME (NLN8022A & B)
	or 15E05838A01	FRAME (NLN8023A & B)
	or 15E05842A01	FRAME (NLN8220A & B)
	or 15E05840A01	FRAME (NLN8221A & B)
	32A84349H01	GASKET, Switch
	4A82453E03	WASHER, Nylon; 2 req'd
	2A82653D03	NUT, Special
	36C84135H01	KNOB, Wing
	3A83174C02	SETSCREW
	14C84729H01	INSULATOR (NLN8020A & B, 8021 A & B)
	or 14C84729H02	INSULATOR (NLN8022A & B, 8023 A & B)
	or 14C84729H05	INSULATOR (NLN8220A & B, 8221A & B)
	32B82172J01	GASKET
	43B84073H01	BUSHING; 2 req'd (NLN8020A & B, 8021A & B, 8221A & B)
	43B84073H03	BUSHING; 2 req'd (NLN8020A & B, 8021A & B, 8221A & B)
	43B84073H03	BUSHING; 4 req'd (NLN8022A & B, 8023A & B, 8220A & B)
	37B84258H01	PAD, Sleeve (NLN8021A & B only)
	43B84228H01	INSERT, Antenna (NLN8020A & B, 8221A & B only)
	41B84727H01	CONTACT, Spring; 2 req'd

NLN8027B Unit Hardware Kit (One-Freq. C.S.)
NLN8028B Unit Hardware Kit (Two-Freq. C.S.)
NLN8029B Unit Hardware Kit (One-Freq. "PL")
NLN8030B Unit Hardware Kit (Two-Freq. "PL") EPD-24587-A

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C90, 186	21K864521	CAPACITOR, fixed: 30 pF ±10%; 75V; N750
		COIL:
L120	24D82723H18	choke, 85 nH; remote speaker-mic models only; p/o xmtr
L123	24D82723H18	choke, 85 nH; internal speaker-mic models only; p/o xmtr
L129	24D82723H04	choke, 0.29 uH; p/o xmtr
	NONREFERENCED ITEMS	
	13D05484A02	ESCUTCHEON (NLN8027B, NLN8029B)
	or 13D05484A03	ESCUTCHEON (NLN8028B
	or 13D05484A13	ESCUTCHEON (NLN8030B
	36B83573H11	KNOB, Control (except NLN8030B
	3A83174C02	SCREW, Set; 4-40 x 1/8
	75B82423B07	PAD, Rubber (NLN8029B, NLN8030B)
	75A83562H02	PAD, Rubber; (2 req'd)
	36B84763H01	KNOB, Control (NLN8030B)
	22C82591C12	PIN, Roll (NLN8030B)

NOTE:

Replacement diodes and transistors must be ordered by Motorola part number only for optimum performance.

1. General Encoding Method

The following information is included for reference only and may not apply to early Motorola paging systems. Use the appropriate encoder or terminal instruction manual for detailed encoding instructions.

The relationship between the "pager code" and the "Vibrasponder" reeds installed is established by the general encoding method. One or two three-digit code numbers are stamped on the code identification label. In single code models only one code number will appear which is usually for individual calling. In dual code models two code numbers will appear; one for individual calling, and the other for group calling.

The 60 paging tone frequencies are divided into six groups of ten tones each. These groups are numbered and designated Tone Group 1, Tone Group 2, etc.. Table 2 shows the tone codes and frequencies.

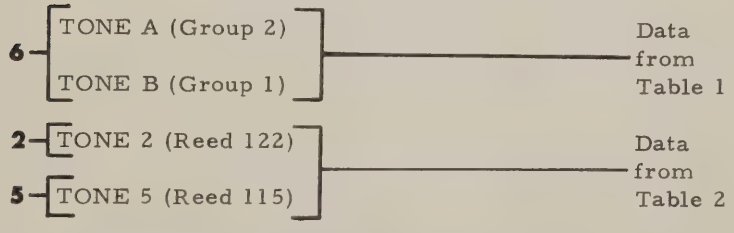
The first digit of the three-digit pager code determines the groups from which Tone A and Tone B will be selected. The tone groups indicated for each first digit are shown in Table 1. The next two digits of the pager code are the specific tones selected from the groups indicated in Table 1, for Tones A and B respectively.

To determine which tone frequencies or reed codes are associated with a given pager code, proceed as follows: look up the first digit of the pager code in Table 1. The groups for Tones A and B will be indicated. Refer to Table 2 and, in the group shown in the previous table for Tone A, the frequency and reed code for Tone A will be indicated on the line corresponding to the second digit of the pager code. The reed code and frequency for Tone B, will be found in the group determined for Tone B, on the line corresponding to the third digit of the pager code.

EXAMPLE I: Pager 625 - According to Table 1, the first digit of this pager (6) indicates that Tone A will be selected from Tone Group 2, and Tone B will be selected from Tone Group 1. The second digit indicates that tone 2 of group 2 will be used for Tone A, and the third digit shows tone 5 of group 1 for Tone B. This unit will have the following reeds installed:

Pager Code 625 -

Tone A - Reed Code 122, Frequency 634.5 Hz.
Tone B - Reed Code 115, Frequency 433.7 Hz.

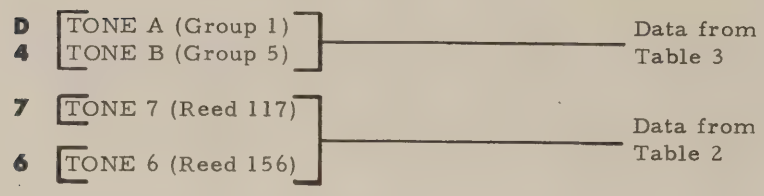


2. Code Type Assignment Encoding Method

This encoding method has been devised to accommodate the large number of pagers used in high capacity paging systems such as the L08 Encoder or the L09 Dial Interconnected Paging Terminal. Pagers encoded by this method are assigned a letter prefix. This prefix is the "Code Type" designation. In the general encoding method, the relationship between the first digit of the pager code and the groups selected is arbitrary. In the code assignment method, the selected groups depend on the system code type. In essence, each code type column in this table is used in the same way as Table 1 was used in the general encoding method. In the column for the pager prefix, on the line corresponding to the first digit of the pager code, will be located the tone groups from which Tones A and B will be selected. Table 2 and the second and third digits of the pager code will determine the exact reed codes as outlined in Paragraph 1.

EXAMPLE II: Pager D476 would have the following reeds installed:

Tone A - Reed Code 117, Frequency 483.5 Hz.
Tone B - Reed Code 156, Frequency 767.4 Hz.



3. Alternate Receiver Coding

Dial interconnected paging terminals provide spare receivers to substitute for regular pagers that are temporarily out of service. Spare receivers are encoded so that they will not duplicate codes within the system, yet will easily substitute for system pagers. Spare tones are used for Tone A which are not part of any of the regular tone groups. Tone B is selected from the regular tone groups. Alternate receiver codes always have repeating second and third digits. The first digit of alternate pager code determines both the spare tone to be used for Tone A, and the regular tone group from which Tone B will be selected. The second or third digit indicates the specific reed to be used for Tone B.

Two encoding methods are used for alternate receivers, a general encoding method for medium capacity systems, and the code type assignment method for high capacity systems. Generally, encoded alternate pagers will have a three-digit code with no letter prefix. Code type assignment alternate pager codes are prefixed with the system code type letter. To find the reed assignments for an alternate pager, refer to the applicable paragraph below.

(a) General Alternate Receiver Encoding Method

Look up the first digit of the alternate pager code in Table 4. On the line corresponding to this digit, the tone A reed and the group from which tone B will be selected are listed. Then look up the second digit of the alternate pager code in Table 2. Refer to the group indicated in the previous step for tone B.

EXAMPLE: Alternate pager code 366, refer to Table 4; first digit (3) indicates reed code 130, frequency 979.9 Hz for tone A and tone B selection from group 2. Refer to Table 2, the second digit (6) in Group 2 indicates reed code 126, frequency 788.5 Hz for tone B.

(b) Code Type Assignment Alternate Receiver Encoding Method

Alternate receivers in systems using this type of encoding have pager codes prefixed with the system code type letter. The tone A reed and group specified by the first digit of this pager code vary with the code type letter. To obtain this information, refer to Table 6 in the code type column specified by the letter prefix, selecting tone A from Table 5 and Tone B as outlined in paragraph (a).

EXAMPLE III: Alternate pager B455; Refer to Table 6 in the code type B row. On first digit column 4, tone A reed code S20 and tone B selection from tone Group 3 is indicated. In Table 2, on line 5, column 3, reed code 160, frequency 953.7 Hz, is indicated for tone B.

SUMMARY: Alternate pager B455 has the following reeds installed.

Tone A = Reed Code S20, Frequency 1500 Hz.
Tone B = Reed Code 160, Frequency 953.7 Hz.

CCD

TONE GROUP 4		TONE GROUP 5		TONE GROUP 6	
ED DE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)
	339.6	151	584.8	191	1153.4
2	358.6	152	617.4	192	1185.2
3	378.6	153	651.9	193	1217.8
4	399.8	154	688.3	194	1251.4
5	422.1	155	726.8	195	1285.8
6	445.7	156	767.4	196	1321.2
7	470.5	157	810.2	197	1357.6
8	496.8	158	855.5	198	1395.0
9	524.6	159	903.2	199	1433.4
0	321.7	150	553.9	190	1122.5

EPF-766-O

N	P	Q	R	S	T	U	V	W	Z
A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B
23	23	24	24	25	34	34	35	46	78
22	22	22	22	22	43	43	53	64	79
33	33	42	42	52	33	33	33	56	87
32	32	44	44	26	44	44	36	44	97
55	26	55	26	55	55	36	55	55	89
25	66	25	66	66	35	66	66	66	98
52	62	45	62	62	45	63	63	45	77
35	36	54	46	56	54	46	56	54	88
53	63	52	64	65	53	64	65	65	99

EPF-398-B

F

TABLE 5

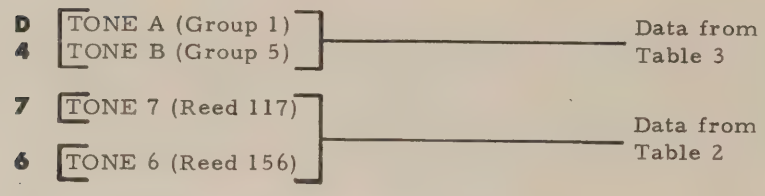
SPARE TONE	S20	1500 Hz
SPARE TONE	CQ	1550 Hz
SPARE TONE	S22	1600 Hz

AEPF-777-O

Selective Call Radio
General Encoding Chart
Motorola No. PEPF-769-A
8/12/74 - JS

EXAMPLE II: Pager D476 would have the following reeds installed:

Tone A - Reed Code 117, Frequency 483.5 Hz.
Tone B - Reed Code 156, Frequency 767.4 Hz.



3. Alternate Receiver Coding

Dial interconnected paging terminals provide spare receivers to substitute for regular pagers that are temporarily out of service. Spare receivers are encoded so that they will not duplicate codes within the system, yet will easily substitute for system pagers. Spare tones are used for Tone A which are not part of any of the regular tone groups. Tone B is selected from the regular tone groups. Alternate receiver codes always have repeating second and third digits. The first digit of alternate pager code determines both the spare tone to be used for Tone A, and the regular tone group from which Tone B will be selected. The second or third digit indicates the specific reed to be used for Tone B.

Two encoding methods are used for alternate receivers, a general encoding method for medium capacity systems, and the code type assignment method for high capacity systems. Generally, encoded alternate pagers will have a three-digit code with no letter prefix. Code type assignment alternate pager codes are prefixed with the system code type letter. To find the reed assignments for an alternate pager, refer to the applicable paragraph below.

(a) General Alternate Receiver Encoding Method

Look up the first digit of the alternate pager code in Table 4. On the line corresponding to this digit, the tone A reed and the group from which tone B will be selected are listed. Then look up the second digit of the alternate pager code in Table 2. Refer to the group indicated in the previous step for tone B.

EXAMPLE: Alternate pager code 366, refer to Table 4; first digit (3) indicates reed code 130, frequency 979.9 Hz for tone A and tone B selection from group 2. Refer to Table 2, the second digit (6) in Group 2 indicates reed code 126, frequency 788.5 Hz for tone B.

(b) Code Type Assignment Alternate Receiver Encoding Method

Alternate receivers in systems using this type of encoding have pager codes prefixed with the system code type letter. The tone A reed and group specified by the first digit of this pager code vary with the code type letter. To obtain this information, refer to Table 6 in the code type column specified by the letter prefix, selecting tone A from Table 5 and Tone B as outlined in paragraph (a).

EXAMPLE III: Alternate pager B455; Refer to Table 6 in the code type B row. On first digit column 4, tone A reed code S20 and tone B selection from tone Group 3 is indicated. In Table 2, on line 5, column 3, reed code 160, frequency 953.7 Hz, is indicated for tone B.

SUMMARY: Alternate pager B455 has the following reeds installed.

Tone A = Reed Code S20, Frequency 1500 Hz.
Tone B = Reed Code 160, Frequency 953.7 Hz.

TABLE 6

CODE TYPE	FIRST DIGIT	1	2	3	4	5	6	7	8	9
B	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	1	2	2	3	3	1	1	1	1
C	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	1	2	2	4	4	1	1	4	4
D	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	1	2	2	5	5	1	1	5	2
E	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	1	2	2	1	6	6	1	6	2
F	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	1	3	3	4	1	4	1	4	3
G	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	1	3	3	5	1	5	1	5	3
H	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	1	3	3	3	6	6	1	6	3
J	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	1	4	1	4	5	5	5	4	1
K	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	1	4	1	4	6	6	1	6	4
L	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	1	5	1	6	5	6	1	6	5
M	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	3	2	3	4	2	4	2	4	3
N	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	3	2	3	2	5	5	2	5	3
P	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	3	2	3	2	6	6	2	6	3
Q	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	4	2	2	4	5	5	5	4	2
R	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	4	2	2	4	6	6	6	6	4
S	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	5	2	2	6	5	6	2	6	5
T	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	4	3	3	4	5	5	5	4	3
U	Tone A Reed	S20	S20	CQ	CQ	S20	CQ	S22	S22	S22
	Tone B Reed	4	3	3	4	6	6	3	6	4
V	Tone A Reed	S20	S20	CQ	S20	CQ	CQ	S22	S22	S22
	Tone B Reed	5	3	3	6	5	6	3	6	5
W	Tone A Reed	S20	S20	CQ	CQ	S20	S22	CQ	S22	S22
	Tone B Reed	6	4	6	4	5	6	5	4	5
Y	Tone A Reed	S20	S20	S20	CQ	CQ	CQ	S22	S22	S22
	Tone B Reed	A2	B	Z	B	Z	A	A	Z	B

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FIRST DIGIT OF PAGER CODE	TONE GROUP FROM WHICH TONE A IS SELECTED	TONE GROUP FROM WHICH TONE B IS SELECTED
1	1	1
2	2	2
3	1	2
4	4	4
5	5	5
6	2	1
7	4	5
8	5	4
9	2	4
0	4	2
A	3	3

EPF-396-C

TABLE 2

TONE CODE

TONE NUMBER	TONE GROUP 1		TONE GROUP 2		TONE GROUP 3		TONE GROUP 4		TONE GROUP 5		TONE GROUP 6	
	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)	REED CODE	FREQ. (Hz)
1	111	349.0	121	600.9	138	288.5	141	339.6	151	584.8	191	1153.4
2	112	368.5	122	634.5	108	296.5	142	358.6	152	617.4	192	1185.2
3	113	389.0	123	669.9	139	304.7	143	378.6	153	651.9	193	1217.8
4	114	410.8	124	707.3	109	313.0	144	399.8	154	688.3	194	1251.4
5	115	433.7	125	746.8	160	953.7	145	422.1	155	726.8	195	1285.8
6	116	457.9	126	788.5	130	979.9	146	445.7	156	767.4	196	1321.2
7	117	483.5	127	832.5	161	1006.9	147	470.5	157	810.2	197	1357.6
8	118	510.5	128	879.0	131	1034.7	148	496.8	158	855.5	198	1395.0
9	119	539.0	129	928.1	162	1063.2	149	524.6	159	903.2	199	1433.4
0	110	330.5	120	569.1	189	1092.4	140	321.7	150	553.9	190	1122.5

EPF-766-O

TABLE 3
CODE PLAN

CODE TYPE	B	C	D	E	F	G	H	J	K	L	M	N	P	Q	R	S	T	U	V	W	Z
FIRST DIGIT	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B	A/B
1	11	11	11	11	11	11	11	11	11	11	23	23	23	24	24	25	34	34	35	46	78
2	22	22	22	22	13	13	13	14	14	15	22	22	22	22	22	22	43	43	53	64	79
3	33	12	12	12	33	33	33	41	41	51	33	33	33	42	42	52	33	33	33	56	87
4	12	44	15	21	44	31	31	44	44	16	44	32	32	44	44	26	44	44	36	44	97
5	13	14	55	16	31	55	16	55	16	55	32	55	26	55	26	55	55	36	55	55	89
6	21	21	21	66	14	15	66	15	66	66	24	25	66	25	66	66	35	66	66	66	98
7	31	41	51	61	41	51	61	45	61	61	42	52	62	45	62	62	45	63	63	45	77
8	23	24	25	26	34	35	36	54	46	56	34	35	36	54	46	56	54	46	56	54	88
9	32	42	52	62	43	53	63	51	64	65	43	53	63	52	64	65	53	64	65	65	99

EPF-398-B

TABLE 4

FIRST DIGIT OF ALTERNATE PAGER CODE	TONE A		TONE GROUP FROM WHICH TONE B IS SELECTED
	CODE	FREQ.	
1	160	953.7	1
2	160	953.7	2
3	130	979.9	2
4	160	953.7	4
5	160	953.7	5
6	130	979.9	1
7	130	979.9	5
8	130	979.9	4

EPF-400-C

TABLE 5

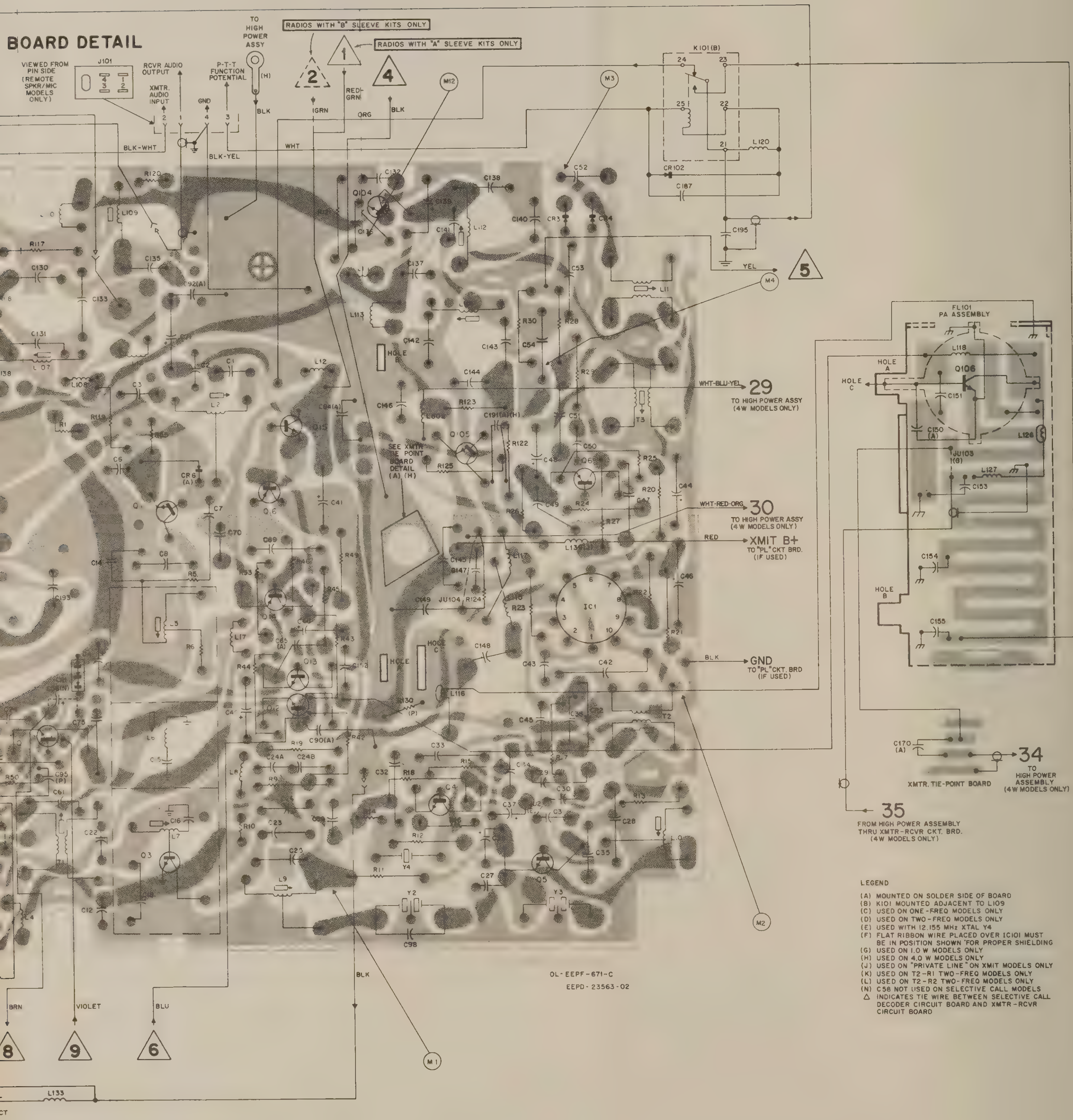
SPARE TONE	S20	1500 Hz
SPARE TONE	CQ	1550 Hz
SPARE TONE	S22	1600 Hz

AEPF-777-O

Summary: Alternate Pager 366 has the following reeds installed:

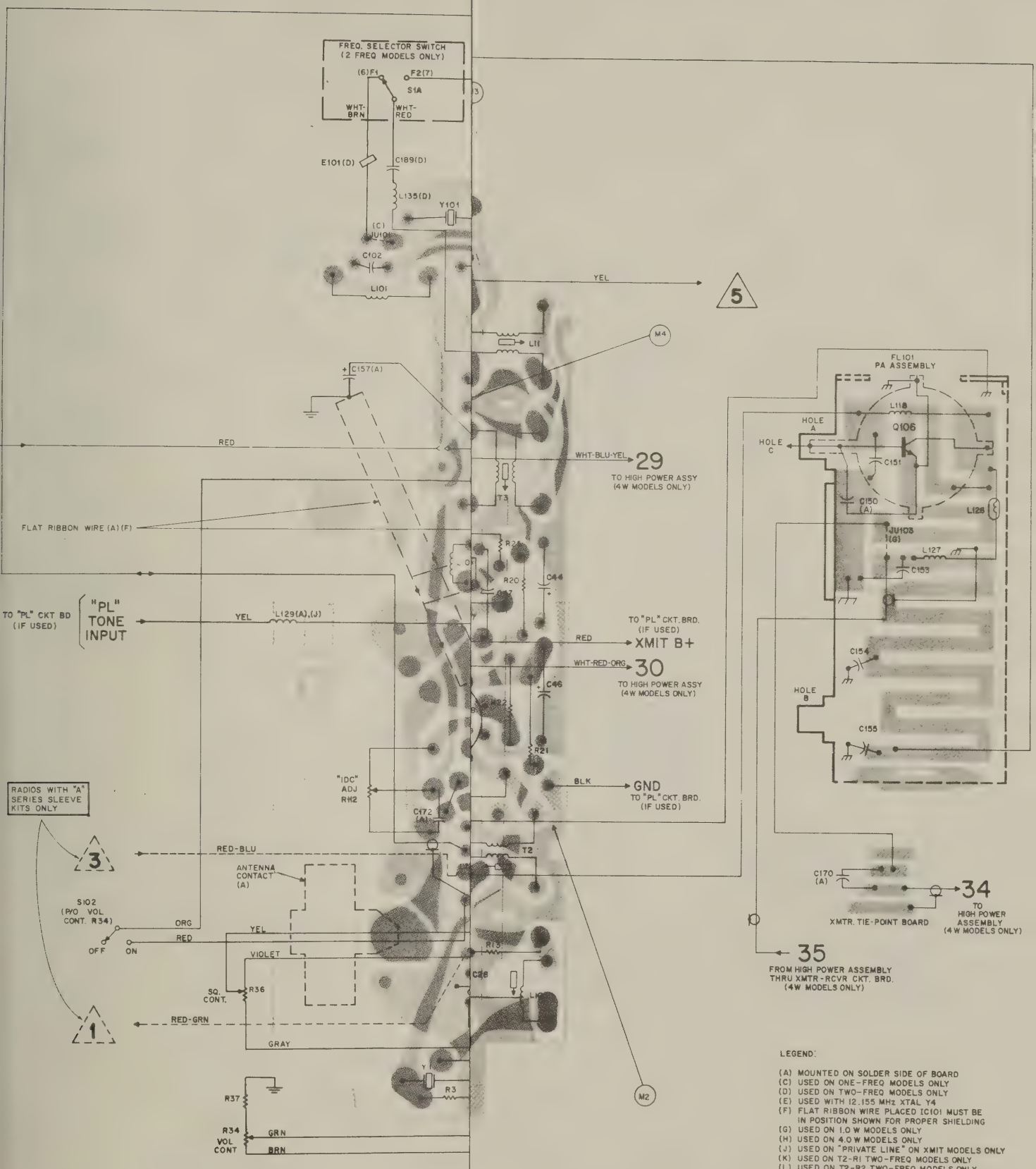
Tone A = Filter Code 130, Frequency 979.9 Hz.
Tone B = Filter Code 126, Frequency 788.5 Hz.

BOARD DETAIL



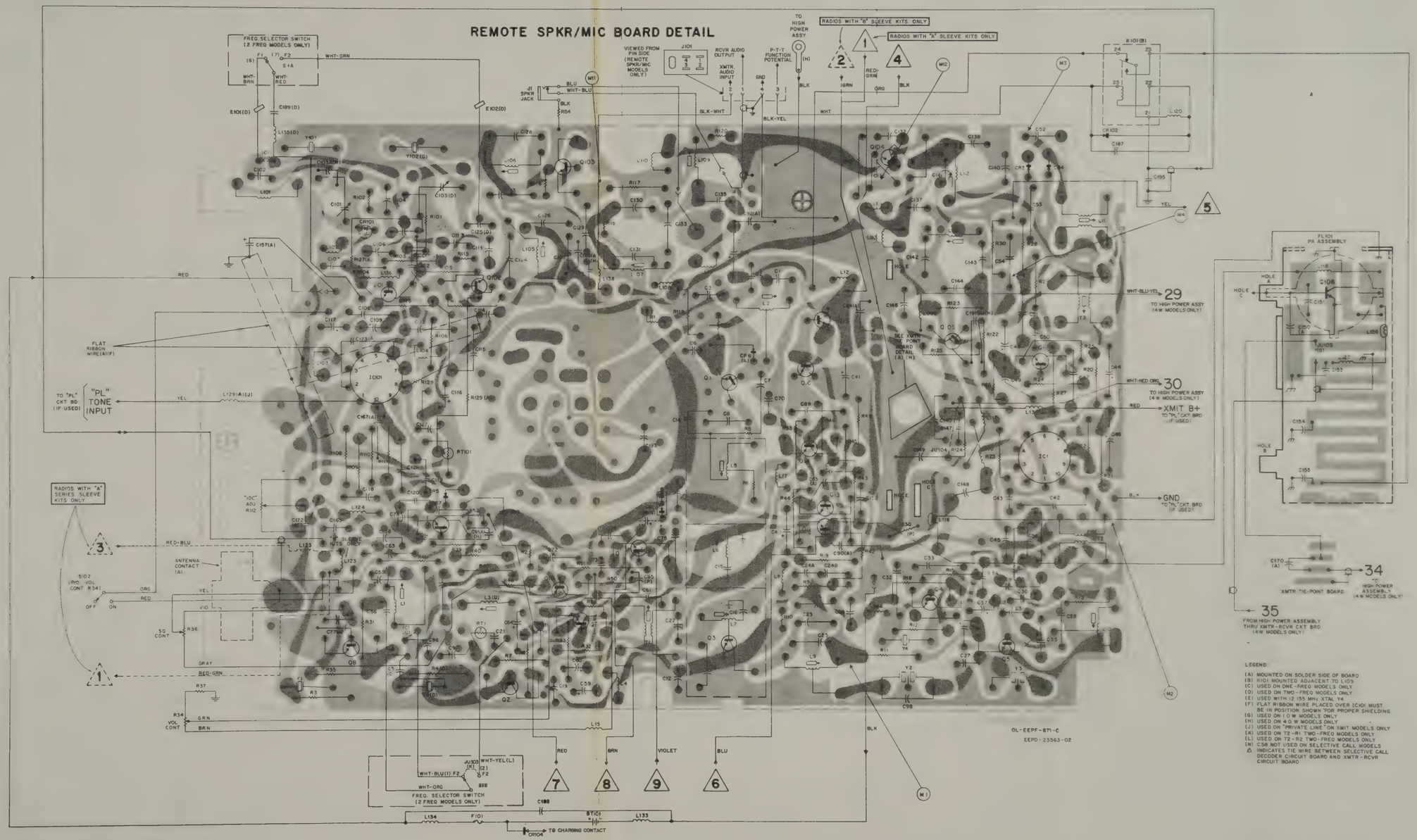
LEGEND

(A) MOUNTED ON SOLDER SIDE OF BOARD
(B) K101 MOUNTED ADJACENT TO L109
(C) USED ON ONE-FREQ MODELS ONLY
(D) USED ON TWO-FREQ MODELS ONLY
(E) USED WITH 12.155 MHz XTAL Y4
(F) FLAT RIBBON WIRE PLACED OVER IC101 MUST BE IN POSITION SHOWN FOR PROPER SHIELDING
(G) USED ON 1.0 W MODELS ONLY
(H) USED ON 4.0 W MODELS ONLY
(J) USED ON "PRIVATE LINE" ON XMIT MODELS ONLY
(K) USED ON T2-R1 TWO-FREQ MODELS ONLY
(L) USED ON T2-R2 TWO-FREQ MODELS ONLY
(N) C58 NOT USED ON SELECTIVE CALL MODELS
△ INDICATES TIE WIRE BETWEEN SELECTIVE CALL DECODER CIRCUIT BOARD AND XMTR-RCVR CIRCUIT BOARD



-02

nsmitter-Receiver
nted Circuit Board Detail
ernal Speaker-Microphone Models)
torola No. PEPF-670-C
2/74 - JS

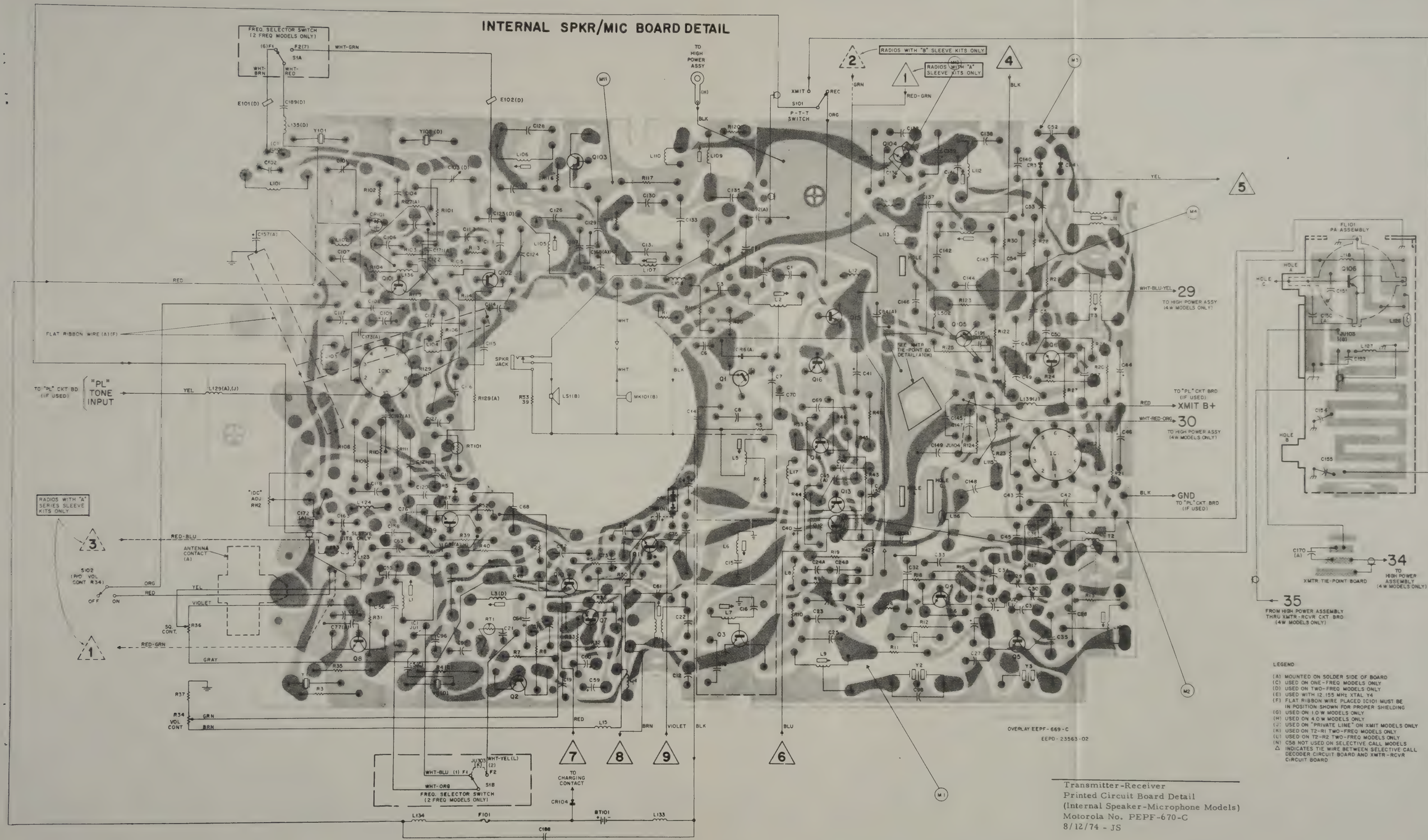


LEGEND

(A) MOUNTED ON SOLDER SIDE OF BOARD
(B) K101 MOUNTED ADJACENT TO L109
(C) USED ON ONE-FREQ MODELS ONLY
(D) USED ON TWO-FREQ MODELS ONLY
(E) USED WITH 12.155 MHz XTAL Y4
(F) FLAT RIBBON WIRE PLACED OVER IC101 MUST BE IN POSITION SHOWN FOR PROPER SHIELDING
(G) USED ON 1.0 W MODELS ONLY
(H) USED ON 4.0 W MODELS ONLY
(J) USED ON "PRIVATE LINE" ON XMIT MODELS ONLY
(K) USED ON T2-R1 TWO-FREQ MODELS ONLY
(L) USED ON T2-R2 TWO-FREQ MODELS ONLY
(N) C58 NOT USED ON SELECTIVE CALL MODELS
Δ INDICATES TIE WIRE BETWEEN SELECTIVE CALL DECODER CIRCUIT BOARD AND XMTR-RCVR CIRCUIT BOARD

Transmitter-Receiver
Printed Circuit Board Detail
(Remote Speaker-Microphone Models)
Motorola No. PEPF-673-C
8/12/74 - JS

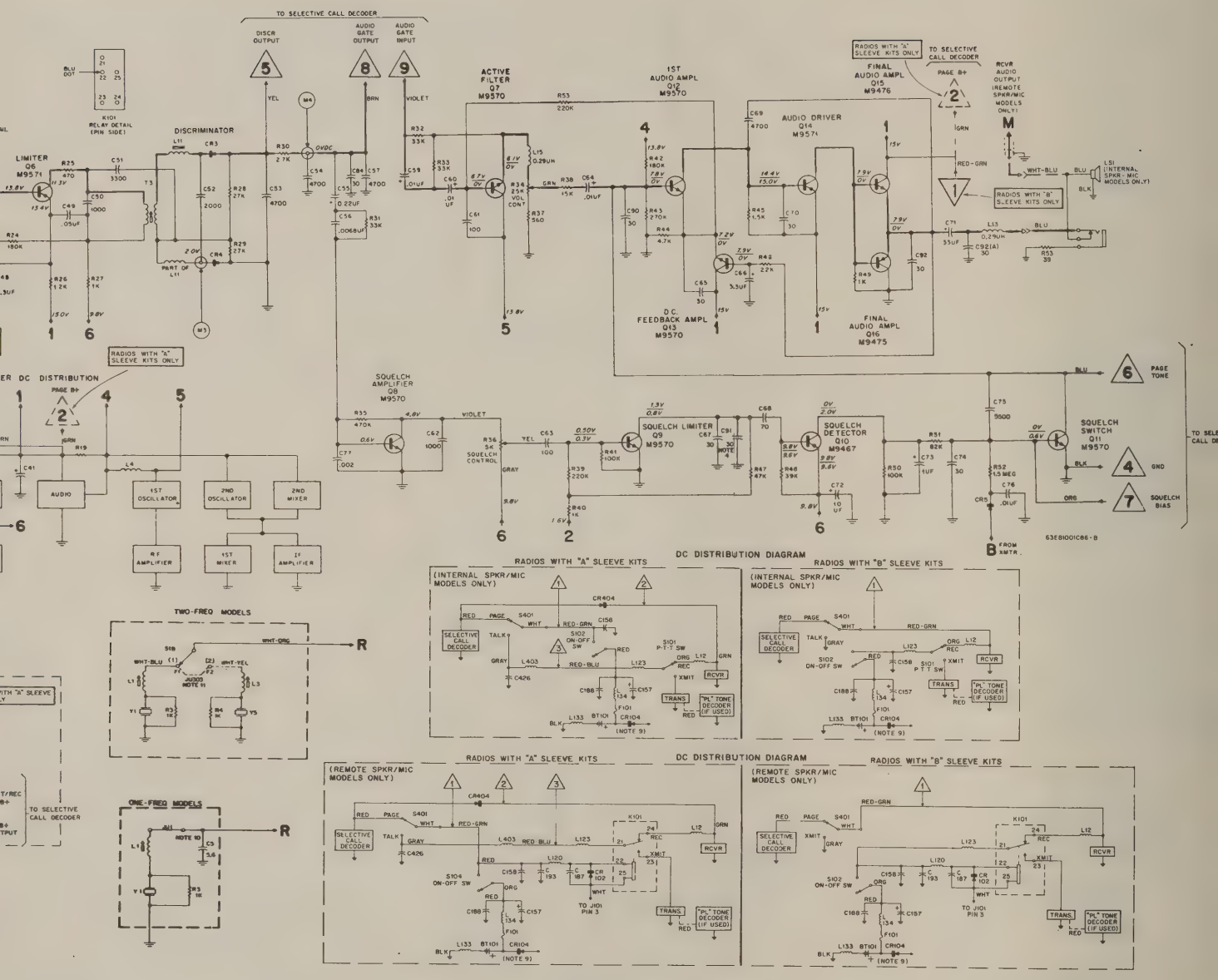
INTERNAL SPKR/MIC BOARD DETAIL



LEGEND

(A) MOUNTED ON SOLDER SIDE OF BOARD
(C) USED ON ONE-FREQ MODELS ONLY
(D) USED ON TWO-FREQ MODELS ONLY
(E) USED WITH 12.155 MHz XTAL Y4
(F) FLAT RIBBON WIRE PLACED IC101 MUST BE IN POSITION SHOWN FOR PROPER SHIELDING
(G) USED ON 1.0 W MODELS ONLY
(H) USED ON 4.0 W MODELS ONLY
(J) USED ON "PRIVATE LINE" ON XMIT MODELS ONLY
(K) USED ON T2-R1 TWO-FREQ MODELS ONLY
(L) USED ON T2-R2 TWO-FREQ MODELS ONLY
(N) C58 NOT USED ON SELECTIVE CALL MODELS
△ INDICATES TIE WIRE BETWEEN SELECTIVE CALL DECODER CIRCUIT BOARD AND XMTR-RCVR CIRCUIT BOARD

Transmitter-Receiver
Printed Circuit Board Detail
(Internal Speaker-Microphone Models)
Motorola No. PEPF-670-C
8/12/74 - JS


TO SELECTIVE CALL DECODER
DISCR OUTPUT
AUDIO GATE OUTPUT
AUDIO GATE INPUT
K101 RELAY DETAIL (PIN SIDE)
DISCRIMINATOR
LIMITER Q6 M9571
ACTIVE FILTER Q7 M9570
1ST AUDIO AMPL Q12 M9570
AUDIO DRIVER Q14 M9574
FINAL AUDIO AMPL Q15 M9476
RADIOS WITH "A" SLEEVE KITS ONLY
RADIOS WITH "B" SLEEVE KITS ONLY
RCVR AUDIO OUTPUT (REMOTE SPKR/MIC MODELS ONLY)
D.C. FEEDBACK AMPL Q13 M9570
FINAL AUDIO AMPL Q16 M9475
SQUELCH AMPLIFIER Q8 M9570
SQUELCH LIMITER Q9 M9570
SQUELCH DETECTOR Q10 M9467
SQUELCH SWITCH Q11 M9570
PAGE TONE
GND
SQUELCH BIAS
FROM XMTR.
AUDIO
1ST OSCILLATOR
2ND OSCILLATOR
2ND MIXER
RF AMPLIFIER
1ST MIXER
IF AMPLIFIER
DC DISTRIBUTION DIAGRAM
RADIOS WITH "A" SLEEVE KITS
(INTERNAL SPKR/MIC MODELS ONLY)
RADIOS WITH "B" SLEEVE KITS
(INTERNAL SPKR/MIC MODELS ONLY)
TWO-FREQ MODELS
ONE-FREQ MODELS
DC DISTRIBUTION DIAGRAM
RADIOS WITH "A" SLEEVE KITS
(REMOTE SPKR/MIC MODELS ONLY)
RADIOS WITH "B" SLEEVE KITS
(REMOTE SPKR/MIC MODELS ONLY)
SELECTIVE CALL DECODER
"PL" TONE DECODER (IF USED)
TRANS
RCVR
63E81001C86-B

MOTOROLA

INSTRUCTION MANUAL REVISION | FMR-403
for | Issue-1

Manual No. 68P81001C85-D
HT220 "HANDIE-TALKIE" FM RADIO
450-470 MHz

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

REVISION DETAILS

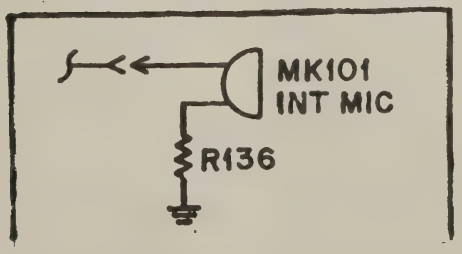
With this change the following becomes effective:

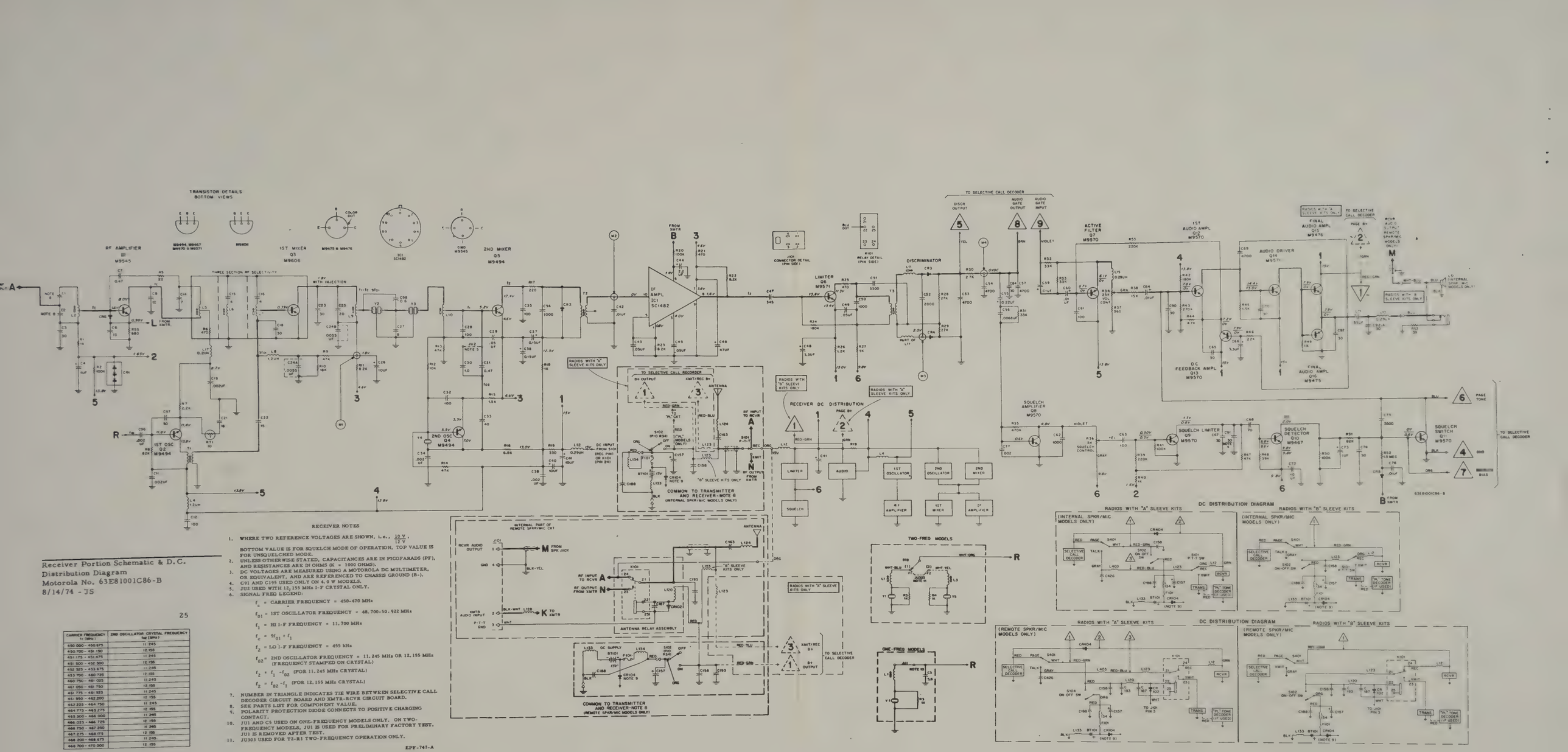
Schematic Diagram	Ckt.Bd. Detail	Kit Number	Suffix	Item No.
----	PEPF-670	NLN8370A	1	1
		NLN8371A	1	

CHANGES

Item No.	Ref. Sym.	Action	Part Number	Description
1	R136	added	0600185B89	RESISTOR, Fixed: 6.8 k ±10%; 1/8 W for location see Detail "A"

DETAIL "A"





RECEIVER NOTES

1. WHERE TWO REFERENCE VOLTAGES ARE SHOWN, i.e., 10 V / 12 V, BOTTOM VALUE IS FOR SQUELCH MODE OF OPERATION, TOP VALUE IS FOR UNSQUELCHED MODE.
2. UNLESS OTHERWISE STATED, CAPACITANCES ARE IN PICOFARADS (PF), AND RESISTANCES ARE IN OHMS (K = 1000 OHMS).
3. DC VOLTAGES ARE MEASURED USING A MOTOROLA DC MULTIMETER, OR EQUIVALENT, AND ARE REFERENCED TO CHASSIS GROUND (B-).
4. C91 AND C195 USED ONLY ON 4.0 W MODELS.
5. JU2 USED WITH 12.155 MHz I-F CRYSTAL ONLY.
6. SIGNAL FREQ LEGEND:
   - f_c = CARRIER FREQUENCY = 450-470 MHz
   - f_{01} = 1ST OSCILLATOR FREQUENCY = 48.700-50.922 MHz
   - f_1 = HI I-F FREQUENCY = 11.700 MHz
   - $f_c = 9f_{01} + f_1$
   - f_2 = LO I-F FREQUENCY = 455 kHz
   - f_{02} = 2ND OSCILLATOR FREQUENCY = 11.245 MHz OR 12.155 MHz (FREQUENCY STAMPED ON CRYSTAL)
   - $f_2 = f_1 - f_{02}$ (FOR 11.245 MHz CRYSTAL)
   - $f_2 = f_{02} - f_1$ (FOR 12.155 MHz CRYSTAL)
7. NUMBER IN TRIANGLE INDICATES TIE WIRE BETWEEN SELECTIVE CALL DECODER CIRCUIT BOARD AND XMTR-RCVR CIRCUIT BOARD.
8. SEE PARTS LIST FOR COMPONENT VALUE.
9. POLARITY PROTECTION DIODE CONNECTS TO POSITIVE CHARGING CONTACT.
10. JU1 AND G5 USED ON ONE-FREQUENCY MODELS ONLY. ON TWO-FREQUENCY MODELS, JU1 IS USED FOR PRELIMINARY FACTORY TEST. JU1 IS REMOVED AFTER TEST.
11. JU303 USED FOR T2-R1 TWO-FREQUENCY OPERATION ONLY.

EPF-747-A

Receiver Portion Schematic & D.C. Distribution Diagram
Motorola No. 63E81001C86-B
8/14/74 - JS

CARRIER FREQUENCY f_c (MHz)	2ND OSCILLATOR CRYSTAL FREQUENCY f_{02} (MHz)
450.000 - 450.675	11.245
450.700 - 451.150	12.155
451.175 - 451.675	11.245
451.500 - 452.500	12.155
452.525 - 453.675	11.245
453.700 - 460.725	12.155
460.750 - 461.025	11.245
461.050 - 461.750	12.155
461.775 - 461.925	11.245
461.950 - 462.200	12.155
462.225 - 464.750	11.245
464.775 - 465.275	12.155
465.300 - 466.000	11.245
466.025 - 466.725	12.155
466.750 - 467.250	11.245
467.275 - 468.175	12.155
468.200 - 468.875	11.245
468.700 - 470.000	12.155

MOTOROLA

INSTRUCTION MANUAL REVISION | FMR-403
for | Issue-1

Manual No. 68P81001C85-D
HT220 "HANDIE-TALKIE" FM RADIO
450-470 MHz

GENERAL

This revision outlines changes that have occurred since the printing of your instruction manual. Use this information to correct your manual.

REVISION DETAILS

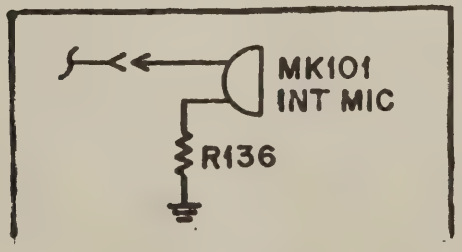
With this change the following becomes effective:

Schematic Diagram	Ckt.Bd. Detail	Kit Number	Suffix	Item No.
----	PEPF-670	NLN8370A	1	1
		NLN8371A	1	

CHANGES

Item No.	Ref. Sym.	Action	Part Number	Description
1	R136	added	0600185B89	RESISTOR, Fixed: 6.8 k ±10%; 1/8 W for location see Detail "A"

DETAIL "A"



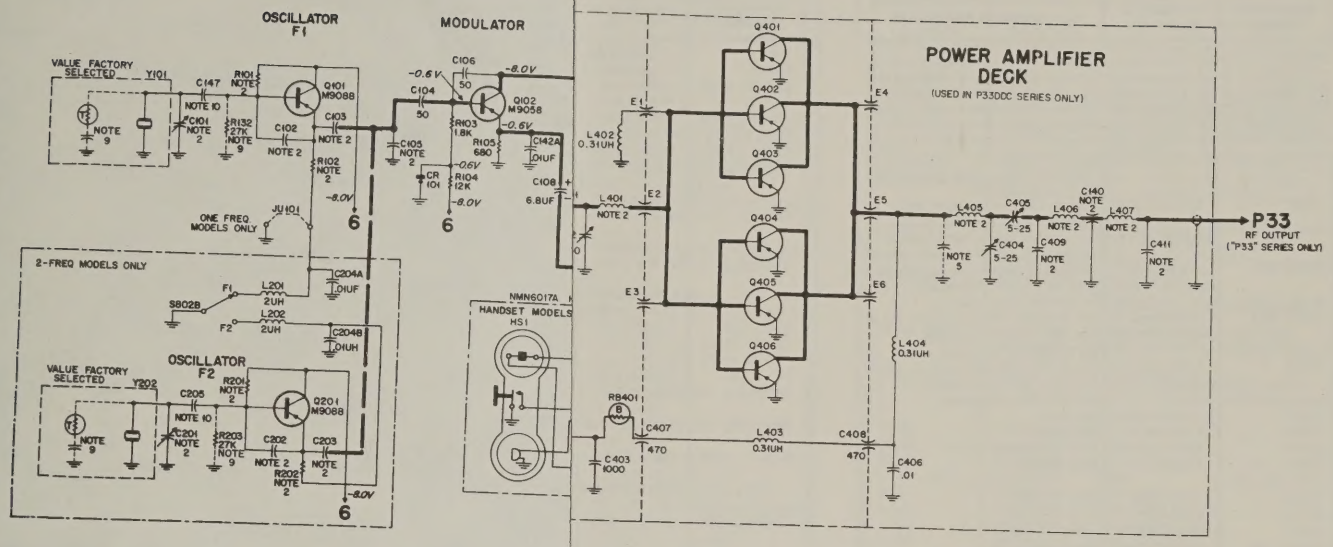
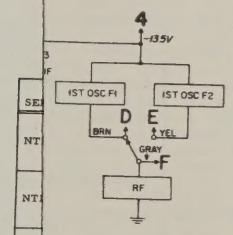
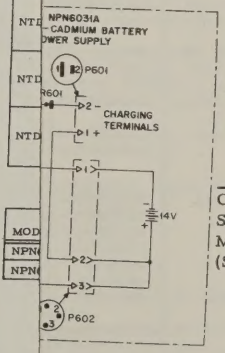


DIAGRAM NO. 63E81017A41





CONTROL PANELS

MODEL NUMBER	SUFFIX	XMTR FREQ	RCVR FREQ	HANDSET	SPEAKER	MICROPHONE
NGN6023A		1	1	X		
NGN6025A		2	1	X		
NGN6026A		2	2	X		
NCN6039A		1	1		X	X
NCN6041A		2	1		X	X
NCN6043A		2	2		X	X
NCN6044A		1	1	X	X	
NCN6045A		1	1		X	X
NCN6047A		2	1		X	X
NCN6049A		2	2		X	X
NCN6052A		1	1	X	X	
NCN6054A		2	2	X	X	
NCN6056A		1	1	X	X	
NCN6058A		2	1	X	X	
NCN6060A		2	2	X	X	
NCN6062A		2	1		X	X

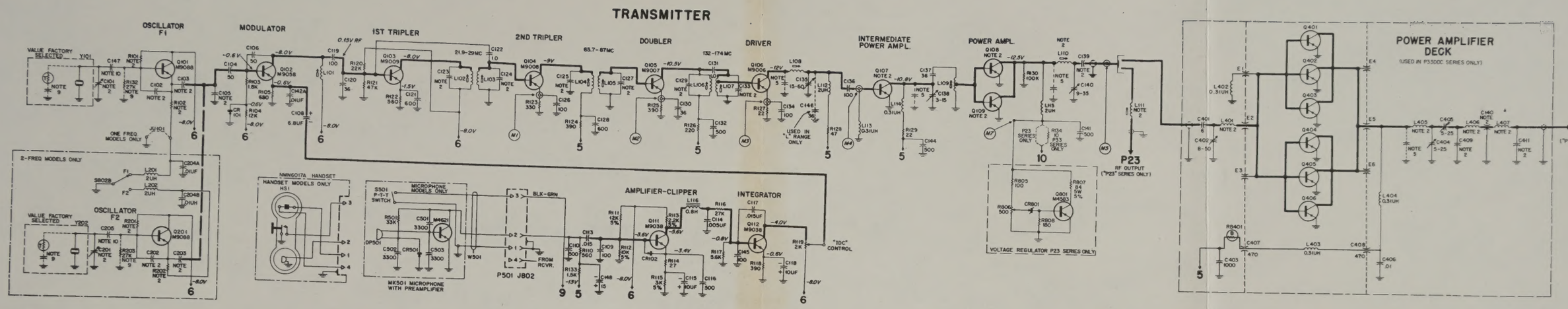
POWER AMPLIFIERS

MODEL NUMBER	SUFFIX	FREQUENCY RANGE
NLD6171A		132-150.8 MC
NLD6172A		150.8-174 MC

VOLTAGE REGULATOR

MODEL NUMBER	CHASSIS SUFFIX
NLN6335A	

Carrier Squelch Radiophone
Schematic Diagram
Motorola No. 63E81017A41-K1
(Sheet 2 of 2)



CONTROL PANELS

MODEL NUMBER	SUFFIX	XMTR FREQ	RCVR FREQ	HANDSET	SPEAKER	MICROPHONE
NGN6023A		1	1	X		
NGN6025A		2	1	X		
NGN6026A		2	2	X		
NCN6039A		1	1		X	X
NCN6041A		2	1		X	X
NCN6043A		2	2		X	X
NCN6044A		1	1	X	X	
NCN6045A		1	1		X	X
NCN6047A		2	1		X	X
NCN6049A		2	2		X	X
NCN6052A		1	1	X	X	
NCN6054A		2	2	X	X	
NCN6056A		1	1	X	X	
NCN6058A		2	1	X	X	
NCN6060A		2	2	X	X	
NCN6062A		2	1		X	X

TRANSMITTERS

SERIES	MODEL NUMBER	CHASSIS SUFFIX	NO. OF FREQ	FREQUENCY RANGE	OSCILLATOR STABILITY	RF POWER OUTPUT
NTD6070AA	NTD6071AA		1	132-150.8 MC	.0025%	1.3 W
	NTD6072AA		1	150.8-168 MC		
	NTD6073AA		1	168-174 MC		
NTD6070AB	NTD6071AB		2	132-150.8 MC		
	NTD6072AB		2	150.8-168 MC		
	NTD6073AB		2	168-174 MC		
NTD6080AA	NTD6081AA		1	132-150.8 MC	.0005%	
	NTD6082AA		1	150.8-168 MC		
	NTD6083AA		1	168-174 MC		
NTD6080AB	NTD6081AB		2	132-150.8 MC		
	NTD6082AB		2	150.8-168 MC		
	NTD6083AB		2	168-174 MC		
NTD6090AA	NTD6091AA		1	132-150.8 MC		3.0 W
	NTD6092AA		1	150.8-168 MC		
	NTD6093AA		1	168-174 MC		
NTD6090AB	NTD6091AB	1	2	132-150.8 MC		
	NTD6092AB	1	2	150.8-168 MC		
	NTD6093AB	1	2	168-174 MC		

POWER AMPLIFIERS

MODEL NUMBER	SUFFIX	FREQUENCY RANGE
NLD6171A		132-150.8 MC
NLD6172A		150.8-174 MC

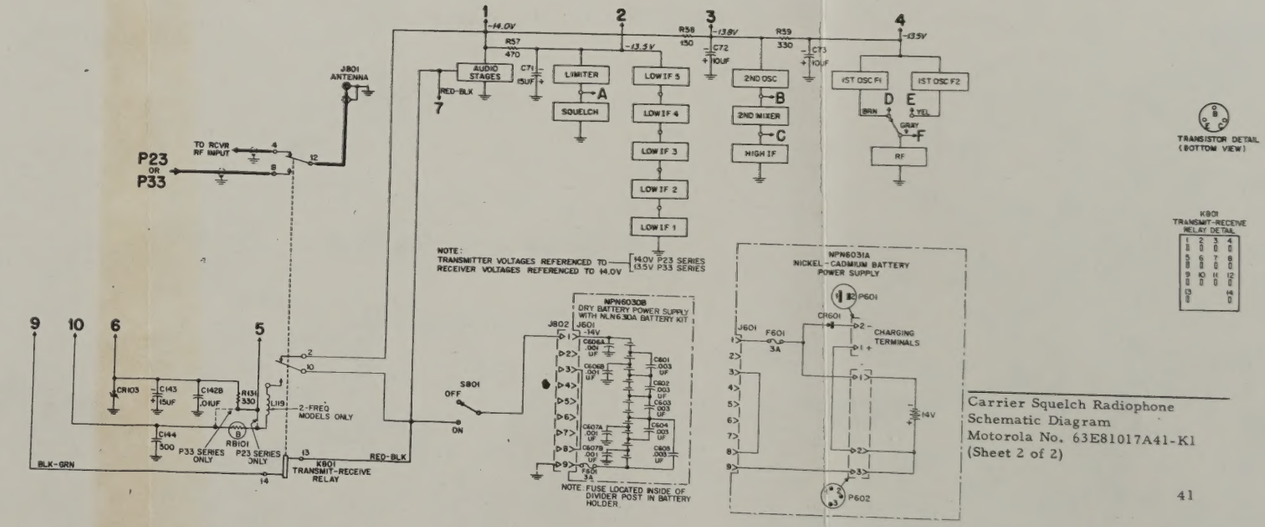
VOLTAGE REGULATOR

MODEL NUMBER	CHASSIS SUFFIX
NLN6335A	

POWER SUPPLIES

MODEL NO.	CHASSIS SUFFIX	TYPE OF BATTERIES
NPN6030B	1	DRY
NPN6031A		NICKEL-CADMIUM

EPD-8627-H



Carrier Squelch Radiophone
Schematic Diagram
Motorola No. 63E81017A41-K1
(Sheet 2 of 2)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NTD6071, 81, 91AA Transmitter Chassis (136-150.8 MC) 1-Freq.		
NTD6072, 82, 92AA Transmitter Chassis (150.8-162 MC) 1-Freq.		
NTD6073, 83, 93AA Transmitter Chassis (162-174 MC) 1-Freq.		
NTD6071, 81, 91AB Transmitter Chassis (136-150.8 MC) 2-Freq.		
NTD6072, 82, 92AB Transmitter Chassis (150.8-162 MC) 2-Freq.		
NTD6073, 83, 93AB Transmitter Chassis (162-174 MC) 2-Freq.		
		CAPACITOR, fixed: uuf; ±10%; 75 v; unl. stated
C101	20C82399D06	var; 3-15; 200 v; N650; BLU (NTD6070 series only)
	or20C82399D08	var; 3-10; 200 v; NP0; GRAY (NTD6080, NTD6090 series only)
C102, 202	21K861436	100; N750 (NTD6070 series only)
	or21D82877B34	150; 50 v; NP0 (NTD6080, NTD6090 series only)
C103, 203	21K861432	20; N150 (NTD6070 series only)
	or21D82877B33	90; 50 v; NP0 (NTD6080, NTD6090 series only)
C104	21K864013	50; N150 (NTD6070 series only)
	or21D82877B31	50; 50 v; NP0 (NTD6080, NTD6090 series only)
C105	21K861434	40; N150
C106	21K864013	50; N150
C108	23C82397D09	6.8 uf +40-20%; 10 v
C109, 126, 134, 136, 145	21K861437	100; N2200
C110	21K861441	100; N4700
C113	8K854329	.015 uf; 200 v
C114	8C82548E03	.005 uf; 100 v
C115, 118	23C82397D03	10 uf ±20%; 6 v
C116, 132, 141, 144	21K847065	500 GMV; 250 v
C117	8C82548E02	.015 uf; 100 v
C119	21K861436	100; N750
C120, 125L, 130, 137	21K861433	36; N150
C121, 128	21K851299	600; 600 v
C122, 131	21C82450B28	1; 500 v
C123L, 124L	21K861435	70; N150
C123M, 123H, 124M, 124H	21K864012	60; N150
C125M, 125H, 127M, 127H	21K865197	25; N150

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C127L	21D82877B06	30; N150
C129L	21K861462	15; N150
C129M, 129H	21K861429	8; N150
C133L	21K861430	10; N150
C133M, 133H	21K861428	6; N150
C135	20C82399D07	var; 15-60; 500 v; N1500; VIO
C138	20C82399D06	var; 3-15; 200 v; N650; BLU
C139L	21D82877B08	2.8 ±0.25 uuf; NP0 (NTD6070, NTD6080 series only)
	or21K840046	100; 500 v (NTD6090 series only)
C139M	21K864014	5; N150 (NTD6070, NTD6080 series only)
	or21K840046	100; 500 v (NTD6090 series only)
C139H	21K861427	4; N150 (NTD6070, NTD6080 series only)
	or21K840046	100; 500 v (NTD6090 series only)
C140	20C82399D05	var; 9-35; 500 v; N650; GRN
C142, 204	21B861469	2 sect; c/o;
C142A, 204A		.01 uf +100-20%
C142B, 204B		.01 uf +100-20%
C143, 148	23C82397D17	15 uf ±20%; 20 v
C146L	21K861433	36; N150 (NTD6080, NTD6090 series only)
C147, 205	21D82877B06	30; N150 (NTD6080, NTD6090 series only)
C201L	20C82399D01	var; 3-15; 200 v; N650 (NTD6070 series only)
	or20C82399D08	var; 3-10; 200 v; NP0; GRAY (NTD6080, NTD6090 series only)
C201M, 201H	20C82399D06	var; 3-15; 200 v; N650; BLU (NTD6070 series only)
	or20C82399D08	var; 3-10; 200 v; NP0; GRAY (NTD6080, NTD6090 series only)
		SEMICONDUCTOR DEVICE, diode; NOTE I
CR101	48C82392B03	silicon
CR102	48C82178A01	germanium
CR103	48C82256C08	zener
		COIL,
L101	24C82901B06	BLK; does not incl. 76B82451B02 CORE, tuning: YEL
L102, 103	24C82904B13	RED-RED; does not incl. 76K861425 CORE, tuning
L104, 105	24C82904B17	YEL-BLK; does not incl. 76K861425 CORE, tuning
L106	24C82904B16	GRAY-BLK; does not incl. 76K861425 CORE, tuning
L107	24B82180E01	driver input; does not incl. 76K861425 CORE, tuning
L108	24C82904B06	RED-GRN; does not incl. 76K861425 CORE, tuning
L109	24B82755D01	PA output; does not incl. 76K861425 CORE, tuning
L110M, 110H	24B82754D01	Final Ampl; does not incl. 76K861425 CORE, tuning
L110L	24C82904B04	RF output; BRN; does not incl 76B82451B04 CORE, tuning (NTD6070, NTD6080 series only)
L111L	24C82904B18	Final Ampl; GRAY-RED; does not incl 76K861425 CORE, tuning
L111M, 111H	24C82904B12	RF output; VIO-GRAY; does not incl. 76B82451B04 CORE, tuning (NTD6070, NTD6080 series only)
L112, 115, 119 201, 202	24C82000E07	choke; RF; 2 uh; sleeved
L113, 114	24C82000E08	choke; RF; 0.31 uh; sleeved
L116	25B82872B01	choke; audio; 0.8 h
		TRANSISTOR, P-N-P; NOTE I
Q101, 201	48R869088	type M9088
Q102	48R869058	type M9058
Q103	48R869009	type M9009
Q104	48R869008	type M9008
Q105	48R869007	type M9007
Q106	48R869006	type M9006
Q107L	48R869005	type M9005 (NTD6070 series only)
	or48R869069	type M9005; BLK (NTD6080, NTD6090 series only)
Q107M	48R869005	type M9005 (NTD6070 series only)
	or48K869056	type M9005; GRN (NTD6080, NTD6090 series only)

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q107H	48K869056	type M9005; GRN
Q108L, 109L	48R869154 or 48R869158	type M9154; YEL (NTD6071AA, AB, NTD6081AA, AB only) type M9158; GRAY (NTD6091AA, AB only)
Q108M, 109M	48R869152 or 48R869157	type M9152; ORG (NTD6072AA, AB, NTD6082AA, AB only) type M9157 (NTD6092AA, AB only)
Q108H, 109H	48R869153 or 48R869155	type M9153; ORG (NTD6073AA, AB, NTD6083AA, AB only) type M9155 (NTD6093AA, AB only)
Q111, 112	48R869038	type M9038
		RESISTOR, fixed: ±10%; 1/4 w; unl. stated
R101, 201	6K129242	56K (NTD6070 series only)
	or6K129225	10K (NTD6080, NTD6090 series only)
R102, 202	6K129231	3.3K (NTD6070 series only)
	or6K128688	2.7K (NTD6080, NTD6090 series only)
R103	6K129269	1.8K
R104	6K129230	12K
R105	6K128599	680
R110, 122	6K129620	560
R111	6K129887	12K ±5%
R112	6K129668	10K ±5%
R113	6K129804	2.2K ±5%
R114	6K131594	27
R115	6S124A60	3K ±5%
R116	6K127806	27K
R117	6K129433	5.6K
R118, 124, 125	6K129863	390
R119	18B82876B04	var; 2K
R120	6K128685	22K
R121	6K127804	4.7K
R123, 131	6K129775	330
R126	6K127800	220
R127, 129	6K131641	22
R128	6K129233	47
R130	6K129226	100K
R132, 203	6K127806	27K (NTD6080, NTD6090 series only)
R133	6S127803	1.5K
R134	6K129755	10
		RESISTOR, current regulating:
RB101	65B82085D01	ballast lamp
		CRYSTAL, quartz: NOTE II
Y101, 201	NLD6200A	xmtr. control
NON-REFERENCED ITEMS		
	1V80722A99	HEAT SINK BRACKET ASSY.

NLD6171A RF Amplifier (132-150.8 MC) ("L")
NLD6172A RF Amplifier (150.8-174 MC) ("M" & "H")

		CAPACITOR, fixed: uuf; unl. stated
C401	21D82204B03	6 ±0.5 uuf; 500 v; NP0
C402	20K840719	var; 8-50; 350 v; N750
C403	21B858836	1000 GMV; 500 v
C404, 405	20K848235	var; 5-25; 350 v; NP0
C406	21K861443	.01 uf +100-20%; 75 v
C407, 408	21C821474	470 ±20%; 500 v
C409L, 411L	21C82880E02	15 ±10%; 500 v
C409M, 409H 411M, 411H	21C82880E01	13 ±10%; 500 v
C410L	21C82881E02	30 ±10%; 500 v
C410M, 410H	21C82881E01	26 ±10%; 500 v
		TERMINAL, feed-thru:
E1, 3, 4, 6	29A82872E01	flange stud
E2, 5	29A82873E01	hook stud
		COIL, RF:
L401	24A82874E01	tuning; (input)
L402, 403, 404	24C82000E04	choke; 0.31 uh (incl. sleeve)
L405	24A82875E01	tuning; (output)
L406L, 407L	24A82892E01	filter
L406M, 406H, 407M, 407H	24A82877E01	filter

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
Q401 to 406	48R869156	TRANSISTOR, P-N-P; M9156; BLU
RB401	65B82840E01	RESISTOR, current regulating: ballast lamp

CONTROL PANEL

NGN6023A	NCN6043A	NCN6052A
NGN6025A	NCN6044A	NCN6054A
NGN6026A	NCN6045A	NCN6056A
NCN6039A	NCN6047A	NCN6058A
NCN6041A	NCN6049A	NCN6060A

J801	9C82817E01	CONNECTOR, receptacle: female; coaxial; uhf type
J802	1V80715A85	female; 4 cont.; does not incl. 2A81180 NUT, ring: knurled
J803	28C82846E01	male; 9 contact
		RELAY, armature: hermetically sealed:
K801	80C82860E01	13.6 v d-c; 4 form "C"; coil res. 160
		LOUDSPEAKER, permanent magnet:
LS801	50D82808E01	3"; square; 50 ohms impedance
		RESISTOR,
R801	18C82816E02	var: 10K ±10%; weatherproof
R802	6K129662	fixed: 180 ±10%; 1/4 w
R803	18C82816E01	var: 5K ±10%; weatherproof
R804	6R6040	fixed: 680 ±10%; 1/2 w
		SWITCH,
S801	40B82851E01	toggle; spst; weather-resistant
S802	40C82843E01	rotary; 2 pole; 2 position; non-shorting (2-freq)

NON-REFERENCED ITEMS

	1V80727A11	HANDLE ASSY.: incl. mic. holding clip (for NCN6039A, NCN6041A, NCN6043A, NCN6045A, NCN6047A, NLN6049A)
	1V80729A93	HANDLE ASSY.: incl. handset holder (for NCN6044A, NCN6052A, NCN6054A, NCN6056A, NCN6058A, NCN6060A, NGN6023A NGN6025A, NGN6026A)
	42K861179	CLAMP, cable; 2 req'd
	42A82143C02	CLAMP, cable
	32B82855E01	GASKET, rubber: housing seal
	36B82812E03	KNOB, control: 2 req'd (vol & sq)
	36B82812E01	KNOB, control: (F1-F2 switch)
	36B82804E01	GASKET: (speaker mtg.)
	35B82803E01	CLOTH, grille
	13C82815E01	GRILLE (1-freq models)
	13C82815E04	GRILLE (2-freq models)
	1V80727A10	HOUSING ASSY.: incl. handle (for NCN6039A, NCN6043A, NCN6045A)
	1V80731A68	HOUSING ASSY.: incl. handle (for NCN6041A, NCN6047A, NCN6049A)
	1V80729A94	HOUSING ASSY.: incl. handle (for NCN6044A, NCN6056A, NGN6023A)
	1V80731A67	HOUSING ASSY.: incl. handle (for NCN6052A, NCN6054A, NCN6058A, NCN6060A, NGN6025A, NGN6026A)

NMN6018A Microphone (plug-in; transistorized)

A501	1V80727A19	AMPLIFIER, AF: incl. C501, C502, C503, CR501, Q501, R501 and 1V80727A20 BOARD, circuit component mtg.

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
C501	21K861442	CAPACITOR, fixed: .002 uf +100-20%; 75 v
C502, 503	21K861436	100 uuf ±10%; 75 v; N750
CR501	48C82178A01	SEMICONDUCTOR DEVICE, diode: NOTE I germanium
DP501	59C82857E01 or59C82864E01	CARTRIDGE, microphone reluctance type
P501		CONNECTOR, plug: p/o W501
Q501	48R134621	TRANSISTOR, NOTE I P-N-P; type M4621
R501	6K127807	RESISTOR, fixed: 33K ±10%; 1/4 w
S501	40C82863E01	SWITCH, push; single pole normally open
W501	30D82565B04	CORD, microphone incl. ref. part P501 and a coiled 4 conductor; stranded cord
NON-REFERENCED ITEMS		
	15C82828E01	HOUSING, microphone: (front)
	15C82827E01	HOUSING, microphone: (rear)
	41B82856E01	SPRING, backup
	38B82833E01	BUTTON, push
	35A82853E01	DIAPHRAGM, microphone
	4C82418B22	WASHER, insulating
	75A82852E01	PAD, rubber: 1.24" dia.
	75A82192A02	PAD, rubber: 0.562" dia.
	64A82826E01	PLATE, tapped
	7B82801E01	BRACKET, hold-down
	32A82661C02	GASKET
	42B82831E01	CLAMP, cable
	1V80727A18	SPRING AND BUSHING ASSY.
	43K475873	SPACER

NPN6031A Power Supply (less battery) Nickel-Cadmium

CR601	48C82095C01	SEMICONDUCTOR DEVICE, diode: NOTE I silicon
F601	65A82496G01	FUSE, cartridge: 3 amp/32 v; 1/4" x 5/8"
J601	9C82847E01	CONNECTOR, receptacle: female: 9 contact
P601	28A82488G01	CONNECTOR, plug: male; 2 contact
P602	28A16313	male; 3 contact
XF601	1V80731A03	FUSEHOLDER ASSY.: single fuse mounting
NON-REFERENCED ITEMS		
	1V80731A01	HOUSING ASSY. (riveted)
	64B82653G01	PLATE, door
	41A82652G01	SPRING, torsion
	22A82651G01	PIN, pivot
	14A82650G01	INSULATOR
	38A868379	TAB, batter plug

NPN6030B Power Supply (less battery) Dry

F601	65R132923	FUSE, cartridge: 3 amp./250 v
J601	9C82847E01	CONNECTOR, receptacle: female: 9 contact
C601, 602, 603 604, 605	21C82187B16	CAPACITOR, fixed .003 uf ±5%; 100 v
C606 C606A, 606B C607	21K800802	2 sections consist of .001 uf GMV +100% max; 500 v same as C606 except consists of; C607A, C607B

REFERENCE SYMBOL	MOTOROLA PART NO.	DESCRIPTION
NON-REFERENCED ITEMS		
	1V80731A83	HOUSING ASSY. (riveted)
	1V80731A85	BATTERY HOLDER ASSY. (riveted)
	1V80731A87	BATTERY COVER ASSY. (riveted)

NLN6335A Voltage Regulator Kit

R805	6K129753	RESISTOR, fixed: 100 ±10%; 1/4 w
R806	18C82035B07	var: 500 ±20%
R807	17C82291B12	fixed: w, w.; 84 ±5%; 5 w
R808	6K129662	fixed: 180 ±10%; 1/4 w
CR801	48C82256C08	SEMICONDUCTOR DEVICE: diode; zener
Q801	48K134583	TRANSISTOR P-N-P; type M4583

NLN6310A Battery Kit (Dry)

	60B82455G01	BATTERY, dry: single cell; 1.5 v; 11 req'd

NMN6017A Handset (Plug-in, Carbon)

HS-1	50D82433G01	HANDSET; carbon incl P1, W1 and the following items: 55P82446G01; HANDLE (only) 15P82446G02; CAP; transmitter 15P82446G03; CAP; receiver 40P82446G04; SWITCH 59P82446G05; CARTRIDGE; receiver 59P82446G06; CARTRIDGE; transmitter 4K84985; WASHER; strain relief 37A842245; SLEEVE; strain relief
W1		CORD; microphone 4 cond; each cond no. 23 ga. str. incl plug (P1); NOTE: connector P1 not replaceable

NOTES:

I. Replacement transistors and diodes must be ordered by Motorola part number only for optimum performance.

II. Crystals are part of the Radio Set Model only. When ordering crystal units specify car. freq.(s), crystal freq.(s) and crystal type number.